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JOURNAL OF THE ROYAL STATISTICAL SOCIETY

PART I, 1936.

URBAN HOUSING IN ENGLAND AND WALES.

By L. R. CONNOR, M.Sc. (Econ.).

[Read before the Royal Statistical Society, November 19th, 1935, the
President, PROFESSOR M. GREENWOOD, F.R.S., in the Chair.]

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(1) *Introduction.*

THE object of this paper is to supply material for a discussion of housing reform from a statistical point of view. Local authorities

are now invested with comprehensive powers and duties with regard to slum clearance, abatement of overcrowding, re-development of congested central areas, repair or demolition of unfit houses and provision of new accommodation for the working classes, and a vigorous campaign against housing evils is in progress. The planning and execution of such a campaign involve a number of statistical problems, including choice of standards, measurement of housing conditions, keeping of records, research into costs, regulation of material and labour supplies, analysis of population movements, apportionment of financial burdens, etc., and it is our purpose to enquire what arrangements exist to this end and in what directions they may be improved. In view of the lapse of time since a paper on Housing * was last read to this Society, we must begin by refreshing our memories. Accordingly, Part I outlines the history of legislation from 1884 to the present day, while Part II discusses the present system of housing inspections and records and arrangements for collecting and publishing statistical data, and Part III deals with a number of topics considered to be of special statistical interest. A summary of the existing law so far as it affects statistical matters is given in the Appendix. In order to make the paper manageable, it is proposed to keep to urban housing in England and Wales and to avoid associated matters, such as the population census, town and country planning, building regulations, and rent restriction, which, however interesting, do not bear directly upon the provision of satisfactory housing for lower-paid workers. Even within these limits there has been heavy pressure upon space and a considerable amount of matter has been squeezed out. Finally, acknowledgments are made to the *Council for Research on Housing Construction* † for permission to reproduce copyright matter; to officials of the Board of Trade, the Ministry of Health and the Ministry of Labour; and to Messrs. J. E. Highton, J. E. Holmstrom, D. Caradog Jones, H. W. Macrosty, J. Calvert Spensley and C. Roland Woods for advice, criticisms and suggestions.

* The last general paper was by J. Calvert Spensley, "Urban Housing Problems," *Jour. Roy. Statist. Soc.*, 1918, Vol. LXXXI, pp. 161-210.

† The aims of the *Council for Research on Housing Construction* are to investigate the housing problem, primarily from the technical aspect, with the object of reducing costs through the fuller use of modern structural methods and materials, but also from other aspects—social, administrative, economic, financial and legal—and to bring results together in a properly co-ordinated scheme. The Council is essentially a body of individuals acting in their personal capacities, and not as representatives of other bodies. Up to the present three reports have been published: *Slum Clearance and Rehousing* (1934); *Housing Standards and Statistics* (1935); and *Housing Finance: Report on Subsidies for Re-housing in Urban Areas* (1935).

PART I—REVIEW OF URBAN HOUSING LEGISLATION—ENGLAND AND WALES.

(2) *Period 1884-1914.**

The modern history of the housing problem begins with the appointment of the *Royal Commission on the Housing of the Working Classes*, 1884,† and the passing of the Housing of the Working Classes Act, 1890.‡ Part I of this Act (Unhealthy Areas) consolidated and amended the “Cross” § Acts; Part II (Unhealthy Dwelling-Houses) consolidated and amended the “Torrens” Acts,|| and provided a simplified procedure for small unhealthy areas; and Part III consolidated and amended existing legislation regarding the provision of new dwellings for the working classes. An important feature from the statistical aspect was the provision for periodical inspections of the district with a view to ascertaining whether any dwelling-house therein was in a state so dangerous or injurious to health as to be unfit for human habitation. In 1909 came the Housing, Town Planning, etc., Act,¶ which strengthened and extended the provisions of the Act of 1890, especially with regard to inspections, a matter in which local authorities had been lax. Detailed regulations were issued by the Local Government Board the following year, and provision was made for the inclusion of statutory tables in the annual reports of medical officers of health. The *Land Enquiry Committee* reported in 1914 that while much had been done, especially since the Act of 1909, there was a shortage of housing accommodation in most towns; that most urban workmen lived in unlovely congested areas, and that 5 to 10 per cent. lived in slums. Proposed reforms included an obligation upon every local authority to make a complete survey of housing conditions (the results to be published) and prepare a scheme with a view to raising the standard to a maximum of adequacy and sanitation; and annual block grants in aid of local rates.** The Local Government Board contemporaneously admitted that housing had become “one of

* For a critical account of this period up to 1907, see Dewsnap, R. A., *The Housing Problem in England: its Statistics, Legislation and Policy*. University Press, Manchester, 1907.

† For a summary of the Commission's findings, see Clarke, J. J., *The Housing Problem: its History, Growth, Legislation and Procedure*. Pitman (1920).

‡ 53 & 54 Vict. c. 70.

§ 38 & 39 Vict. c. 36; 42 & 43 Vict. c. 63, and 45 & 46 Vict. c. 54 (Part II).

|| 29 & 30 Vict. c. 28; 31 & 32 Vict. c. 130; 42 & 43 Vict. c. 64, and 45 & 46 Vict. c. 54.

¶ 9 Edw. 7, c. 44.

** *The Land: the Report of the Land Enquiry Committee*, Vol. 2, “Urban.” Hodder & Stoughton, 1914. See also *Surveyors' Institution Transactions*, Vol. XLVI. pp. 417-27, and Vol. XLVII, pp. 391-409.

the most serious social problems of the present day," and referred to the need for collecting "as complete information as possible of the nature and extent of the problem." * To sum up, with few exceptions there had been general inaction in face of a grave social problem, due in the main to inadequate information, prevailing economic and political theories, regard to vested interests and lack of Exchequer contributions towards local expenses. Little definite statistical information survives and that little cannot be put into continuous, comparative and intelligible form. For details, the authorities noted below should be consulted.†

(3) *Period 1914-1935.*‡

The virtual cessation of housing activities during the War, coupled with high interest rates and building costs, aggravated existing difficulties. In 1919, returns from local authorities indicated a minimum need of 400,000 houses, and the Housing, Town Planning, etc., Act, 1919,§ was passed as an emergency measure. Every local authority were to survey the housing needs of their district and prepare and carry out a housing scheme providing for the whole of working-class needs so far as it was not likely to be met by other agencies; and financial assistance was made available in the shape of an undertaking to reimburse expenditure in excess of the produce of a penny rate. A later Act, the Housing (Additional Powers) Act, 1919,|| provided for lump-sum grants to private persons. A Housing Advisory Council and a Commission on Standardization were appointed, arrangements were made for the supply of materials through the Building Materials Department (closed down in 1921); the Housing Department of the Ministry of Health was reorganized; and the country was divided into eleven regions, each in charge of a housing commissioner. Meanwhile the returns showed an aggregate need of 800,000 houses, but the Ministry declined to accept them as genuine and the survey was dropped. By 1920 plans for 160,000 houses had been approved, but difficulties were caused by shortage of capital, labour and materials, and the cost of building a working-class house had risen to over £1000. It was accordingly decided

* 43rd Report of Local Government Board, 1913-14 (Cd. 7610), Part II.

† Dewsnap, R. A., *The Housing Problem in England*. Sykes, J. F., "State Municipal and Organized Private Action on the Housing of the Working Classes in London and in other Large Cities of the United Kingdom," *Jour. Roy. Statist. Soc.*, 1891, Vol. LXIV, pp. 189-253. Spensley, J. Calvert, "Urban Housing Problems," *Jour. Roy. Statist. Soc.*, 1918, Vol. LXXXI, pp. 161-210. Annual Reports of Local Government Board. Report of the Housing Committee of the Surveyors' Institution, 1917.

‡ This section is based largely upon the Annual Reports of the Ministry of Health.

§ 9 & 10 Geo. 5, c. 35. For details see section (16).

|| 9 & 10 Geo. 5, c. 99.

to limit the number of assisted houses to 176,000, and the subsidy to private enterprise was withdrawn, but an annual sum of £200,000 was voted for slum clearance.

In 1922 there was a change of Government. By 1923 the financial position had improved, building costs had fallen some 60 per cent. below the peak level and private enterprise had begun to revive, and a new Act was passed to stimulate private enterprise. The Housing Act, 1923,* provided for unit grants to local authorities and housing trusts in aid of new building; grants amounting to 50 per cent. of the loss for slum clearance; and advances and guarantees to builders by local authorities. After the change of Government in 1924 a more extensive scheme was adopted. A *National House Building Committee*,† set up to explore the position, reported ‡ that if stability were assured, a comprehensive and continuous programme could be carried out at reasonable cost; offered to revise the apprenticeship system and arrange for a necessary increase in the supply of materials; and estimated to be able to increase the annual output of working-class houses from 90,000 in 1925 to 225,000 in 1934. On this basis the Housing (Financial Provisions) Act, 1924,§ which provided for unit grants on a more liberal scale in respect of houses erected during the next fifteen years, subject to an adequate rate of output being maintained and to the Government's right to reduce the grants in the event of falling costs. In order to attract the higher grants under this Act, the houses provided were subject to "special conditions" regarding rents, etc. Authorities that found the latter too onerous had the option of claiming grants under the Act of 1923. Two Committees were set up to facilitate this programme, as well as an *Inter-Departmental Committee on Prices of Building Materials*, but nevertheless there was a rise in building costs. The change in Government late in 1924 was followed by a cessation of new legislation, but a consolidating Act was passed in 1925.|| Subsidy rates under the Acts of 1923 and 1924 were reduced in 1927, and in 1929 the 1923 subsidy was terminated.

So far little progress had been made with slum clearance. During the period 1919–30, 121 slum-clearance schemes involving demolition of 25,000 buildings and re-housing of 73,000 persons had been confirmed, but progress was arrested by a decision in the *Derby* case.¶ In 1929 there was another change of Government and next year a

* 13 & 14 Geo. 5, c. 24. For details see section (16).

† Comprising representatives of building employers and operatives and manufacturers and merchants of building materials.

‡ Cmd. 2104 (1924).

§ 14 & 15 Geo. 5, c. 35. For details see section (16).

|| Housing Act, 1925 (13 Geo. 5, c. 14).

¶ *Rex v. Minister of Health, ex parte Davis*, 1929. 1. K.B. 619.

new era was opened by the Housing Act, 1930.* It was realized that the policy of concentrating upon new housing and relying on the process of "filtering up" had not proved an unqualified success. Accordingly every urban authority with a population exceeding 20,000 were to formulate and submit a quinquennial statement of the steps proposed for dealing with housing conditions in their area and for providing new accommodation. Areas were to be dealt with either as clearance areas (in which case all buildings were to be demolished) or as improvement areas (in which case some houses could be demolished and others would be repaired and overcrowding would be abated by special by-laws). New Exchequer grants were made available, so that rents might be lowered in the interests of slum-dwellers, provision being made for aggregate rents to be based on costs after taking into account Exchequer and rate contributions, subject to the authority's discretion to vary rents between individuals. The financial conditions of 1931 led to an attack on the subsidy principle by the *Committee on National Expenditure*.† There was another change of Government, and the cry for economy led to the postponement of building programmes, with the natural result of increasing unemployment. At the same time the *Report of the Inter-Departmental Committee on the Rent Restrictions Acts*‡ affirmed that despite the amount of new building the condition of the poorest classes had not been improved as much as might have been expected, for the rents of municipal houses were often higher than those classes could afford. The Minister of Health therefore suggested that local authorities should concentrate their efforts on the three-bedroomed non-parlour type of house within a superficial area of 760 sq. ft., that the rents of houses provided under the Act of 1924 should be calculated without reference to the costs of houses already built by the authority, and that provision should be limited to the number required to meet the urgent need of poor families with children living in overcrowded conditions or in insanitary houses.

By 1932 a fall in building costs and interest rates had made conditions favourable to a vigorous attack upon the slums, and it was decided to call upon local authorities to draw up programmes upon the basis that all areas needing clearance should be cleared by 1938. The same favourable conditions made it possible to take a further step in the direction of bringing back private enterprise, and, acting on the advice of the *Committee on Local Expenditure*,§

* 20 & 21 Geo. 5, c. 39. For details see section (16).

† *Committee on National Expenditure*, 1931 (Cmd. 3920).

‡ *Report of Inter-Departmental Committee on the Rent Restriction Acts*, 1931 (Cmd. 3911).

§ *Report of Committee on Local Expenditure*, 1932 (Cmd. 4200). For a summary of the facts upon which that Committee relied, see section (16).

it was decided to withdraw the 1924 subsidy. Accordingly the Housing (Financial Provisions) Act, 1933,* was passed to this effect. The duty of seeing that working-class needs were met was to remain with the local authorities, and it was not contemplated that they themselves should build unless the need was not likely to be met by private enterprise. In order to ensure easy finance to builders and investors, provision was made for a system of guarantees on building society loans, the risk involved by making advances up to 90 per cent. of the valuations instead of the usual 70 per cent. being shared equally between the State, the local authority and the Society. For their part the Societies undertook to lend money for a term of 30 years (as against the usual 20) at 1 per cent. below the usual rate charged to borrowers.

By March of next year, 1679 slum-clearance programmes or nil returns (out of 1716) had been submitted providing for demolition of 270,000 houses with a population of 1,200,000 persons and the erection of 290,000 replacement dwellings. The Ministry's housing division was strengthened and stronger provisions were made for the keeping of proper records by local authorities. Following on the Report of the *Departmental Committee on Housing*,† the Housing Act, 1935,‡ was passed to deal with the gross evil of overcrowding which had been known and neglected for half a century. Local authorities were to inspect and make reports and submit proposals as to abatement of overcrowding; overcrowding was defined and made a penal offence; urban authorities were to secure re-development of congested central areas and their powers with regard to re-conditioning were extended; provision was made for the establishment of a Central Housing Advisory Committee and Local Housing Management Commissions; local authorities' powers with regard to Housing Associations were extended; new Exchequer grants towards provision of flats on sites of high value and otherwise in special circumstances were made available; provision was made for consolidation of housing accounts and unification of conditions affecting local authorities' houses, and local authorities' by-law making powers were amended and enlarged. A summary of the present law so far as it affects statistical matters is given in the Appendix.

(4) *Statistical Results 1919-1935.*§

While there has been considerable improvement in the quantity and quality of the statistical information published, much remains

* 23 & 24 Geo. 5, c. 15.

† Report of Departmental Committee on Housing, 1933 (Cmd. 4397).

‡ 25 and 26 Geo. 5, c. 40.

§ This section relates to all areas in England and Wales—urban and rural.

TABLE I.

New Houses provided in England and Wales, 1919-35, excluding Houses provided under Improvement and Reconstruction Schemes prior to 1930 Act and Houses over £78 rateable value (£105 in greater London).

Half-year ending	No. of Houses provided by							Grand Total.	Cumulative Grand Total.	Working-class Index of Building Cost.	
	Local Authorities.			Private Enterprise.							
	With State Assistance. (2)	Without State Assistance. (3)	Total. (4)	With State Assistance. (5)	Without State Assistance. (6)	Total. (7)	Total No. provided				
											With State Assistance. (8)	Without State Assistance. (9)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Jan. 1, 1919, to March 31, 1920	570		576	139			715		210,237		211
Sept. 30, 1920	2,926		2,926	2,486			5,412				243
March 31, 1921	12,659		12,659	10,478			23,137		210,237		223
Sept. 30, 1921	31,992		31,992	26,431			58,423				180
March 31, 1922	46,791		46,791	10,472			57,263				111
Sept. 30, 1922	40,185		40,185	9,717			49,902				100
March 31, 1923	17,360	Figures not available	17,360	6,001			23,361		41,751	251,088	105
Sept. 30, 1923	7,891	but may be	7,891	147			8,038		36,087	288,075	109
March 31, 1924	8,092	neglected for working purposes.	8,092	4,164			12,256		38,949	338,108	120
Sept. 30, 1924	15,542		15,542	17,751			33,293		40,252	398,406	123
March 31, 1925	15,542		15,542	29,294			44,836		31,435	475,087	131
Sept. 30, 1925	24,670		24,670	30,907			55,577		76,621	537,492	131
March 31, 1926	36,732		36,732	31,862			68,594		82,406	618,513	133
Sept. 30, 1926	37,361		37,361	38,631			75,992		91,021	765,076	131
March 31, 1927	75,913		75,913	68,687			144,600		106,563	871,142	132
Sept. 30, 1927	28,121		28,121	15,961			44,082		122,163	993,305	127
March 31, 1928	31,059		31,059	22,610			53,669		162,131	1,155,466	119
Sept. 30, 1928	35,743		35,743	26,659			62,402		27,669	1,182,870	111
March 31, 1929	26,010		26,010	22,459			48,469		31,955	1,214,790	110
Sept. 30, 1929	27,560		27,560	24,621			52,181		32,785	1,247,575	108
March 31, 1930	32,705		32,705	49,684			82,389		78,459	1,326,034	106
Sept. 30, 1930	35,371	1,005	36,376	36,743			72,488		123,579	1,449,613	106
March 31, 1931	36,737	1,360	38,097	36,743			73,481		130,232	1,579,845	106
Sept. 30, 1931	36,737	2,000	38,737	36,743			73,481		130,232	1,710,077	105
March 31, 1932	36,737	2,764	39,501	36,743			73,481		130,232	1,840,309	105
Sept. 30, 1932	36,737	3,205	39,942	36,743			73,481		130,232	1,970,541	105
March 31, 1933	36,737	3,711	40,448	36,743			73,481		130,232	2,100,773	105
Sept. 30, 1933	36,737	4,080	40,817	36,743			73,481		130,232	2,231,005	105
March 31, 1934	36,737	4,595	41,332	36,743			73,481		130,232	2,361,237	105
Sept. 30, 1934	36,737	5,060	41,797	36,743			73,481		130,232	2,491,469	99
March 31, 1935	36,737	5,575	42,312	36,743			73,481		130,232	2,621,701	97
Sept. 30, 1935	36,737	6,040	42,777	36,743			73,481		130,232	2,751,933	96
March 31, 1936	36,737	6,505	43,242	36,743			73,481		130,232	2,882,165	96
Sept. 30, 1936	36,737	6,970	43,707	36,743			73,481		130,232	3,012,397	96
March 31, 1937	36,737	7,435	44,172	36,743			73,481		130,232	3,142,629	96
Sept. 30, 1937	36,737	7,900	44,637	36,743			73,481		130,232	3,272,861	96
March 31, 1938	36,737	8,365	45,102	36,743			73,481		130,232	3,403,093	96
Sept. 30, 1938	36,737	8,830	45,567	36,743			73,481		130,232	3,533,325	96
March 31, 1939	36,737	9,295	46,032	36,743			73,481		130,232	3,663,557	96
Sept. 30, 1939	36,737	9,760	46,497	36,743			73,481		130,232	3,793,789	96
March 31, 1940	36,737	10,225	46,962	36,743			73,481		130,232	3,924,021	96
Sept. 30, 1940	36,737	10,690	47,427	36,743			73,481		130,232	4,054,253	96
March 31, 1941	36,737	11,155	47,892	36,743			73,481		130,232	4,184,485	96
Sept. 30, 1941	36,737	11,620	48,357	36,743			73,481		130,232	4,314,717	96
March 31, 1942	36,737	12,085	48,822	36,743			73,481		130,232	4,444,949	96
Sept. 30, 1942	36,737	12,550	49,287	36,743			73,481		130,232	4,575,181	96
March 31, 1943	36,737	13,015	49,752	36,743			73,481		130,232	4,705,413	96
Sept. 30, 1943	36,737	13,480	50,217	36,743			73,481		130,232	4,835,645	96
March 31, 1944	36,737	13,945	50,682	36,743			73,481		130,232	4,965,877	96
Sept. 30, 1944	36,737	14,410	51,147	36,743			73,481		130,232	5,096,109	96
March 31, 1945	36,737	14,875	51,612	36,743			73,481		130,232	5,226,341	96
Sept. 30, 1945	36,737	15,340	52,077	36,743			73,481		130,232	5,356,573	96
March 31, 1946	36,737	15,805	52,542	36,743			73,481		130,232	5,486,805	96
Sept. 30, 1946	36,737	16,270	53,007	36,743			73,481		130,232	5,617,037	96
March 31, 1947	36,737	16,735	53,472	36,743			73,481		130,232	5,747,269	96
Sept. 30, 1947	36,737	17,200	53,937	36,743			73,481		130,232	5,877,501	96
March 31, 1948	36,737	17,665	54,402	36,743			73,481		130,232	6,007,733	96
Sept. 30, 1948	36,737	18,130	54,867	36,743			73,481		130,232	6,137,965	96
March 31, 1949	36,737	18,595	55,332	36,743			73,481		130,232	6,268,197	96
Sept. 30, 1949	36,737	19,060	55,797	36,743			73,481		130,232	6,398,429	96
March 31, 1950	36,737	19,525	56,262	36,743			73,481		130,232	6,528,661	96
Sept. 30, 1950	36,737	19,990	56,727	36,743			73,481		130,232	6,658,893	96
March 31, 1951	36,737	20,455	57,192	36,743			73,481		130,232	6,789,125	96
Sept. 30, 1951	36,737	20,920	57,657	36,743			73,481		130,232	6,919,357	96
March 31, 1952	36,737	21,385	58,122	36,743			73,481		130,232	7,049,589	96
Sept. 30, 1952	36,737	21,850	58,587	36,743			73,481		130,232	7,179,821	96
March 31, 1953	36,737	22,315	59,052	36,743			73,481		130,232	7,309,053	96
Sept. 30, 1953	36,737	22,780	59,517	36,743			73,481		130,232	7,439,285	96
March 31, 1954	36,737	23,245	60,082	36,743			73,481		130,232	7,569,517	96
Sept. 30, 1954	36,737	23,710	60,547	36,743			73,481		130,232	7,699,749	96
March 31, 1955	36,737	24,175	61,012	36,743			73,481		130,232	7,829,981	96
Sept. 30, 1955	36,737	24,640	61,477	36,743			73,481		130,232	7,960,213	96
March 31, 1956	36,737	25,105	61,942	36,743			73,481		130,232	8,090,445	96
Sept. 30, 1956	36,737	25,570	62,407	36,743			73,481		130,232	8,220,677	96
March 31, 1957	36,737	26,035	62,872	36,743			73,481		130,232	8,350,909	96
Sept. 30, 1957	36,737	26,500	63,337	36,743			73,481		130,232	8,481,141	96
March 31, 1958	36,737	26,965	63,802	36,743			73,481		130,232	8,611,373	96
Sept. 30, 1958	36,737	27,430	64,267	36,743			73,481		130,232	8,741,605	96
March 31, 1959	36,737	27,895	64,732	36,743			73,481		130,232	8,871,837	96
Sept. 30, 1959	36,737	28,360	65,197	36,743			73,481		130,232	9,002,069	96
March 31, 1960	36,737	28,825	65,662	36,743			73,481		130,232	9,132,301	96
Sept. 30, 1960	36,737	29,290	66,127	36,743			73,481		130,232	9,262,533	96
March 31, 1961	36,737	29,755	66,592	36,743			73,481		130,232	9,392,765	96
Sept. 30, 1961	36,737	30,220	67,057	36,743			73,481		130,232	9,522,997	96
March 31, 1962	36,737	30,685	67,522	36,743			73,481		130,232	9,653,229	96
Sept. 30, 1962	36,737	31,150	67,987	36,743			73,481		130,232	9,783,461	96
March 31, 1963	36,737	31,615	68,452	36,743			73,481		130,232	9,913,693	96
Sept. 30, 1963	36,737	32,080	68,917	36,743			73,481		130,232	10,043,925	96
March 31, 1964	36,737	32,545	69,382	36,743			73,481		130,232	10,174,157	96
Sept. 30, 1964	36,737	33,010	69,847	36,743			73,481		130,232	10,304,389	96
March 31, 1965	36,737	33,475	70,312	36,743			73,481		130,232	10,434,621	96
Sept. 30, 1965	36,737	33,940	70,777	36,743			73,481		130,232	10,564,853	96
March 31, 1966	36,737	34,405	71,242	36,743			73,481		130,232	10,695,085	96
Sept. 30, 1966	36,737	34,870	71,707	36,743			73,481		130,232	10,825,317	96
March 31, 1967	36,737	35,335	72,172	36,743			73,481		130,232	10,955,549	96
Sept. 30, 1967	36,737	35,800	72,637	36,743			73,481		130,232	11,085,781	96
March 31, 1968	36,737	36,265	73,102	36,743			73,481		130,232	11,216,013	96
Sept. 30, 1968	36,737	36,730	73,567	36,743			73,481		130,232	11,346,245	96
March 31, 1969	36,737	37,195	74,032	36,743			73,481		130,232	11,476,477	96
Sept. 30, 1969	36,737	37,660	74,497	36,743			73,481		130,232	11,606,709	96
March 31, 1970	36,737	38,125	74,962	36,743			73,481		130,232	11,736,941	96
Sept. 30, 1970	36,737	38,590	75,427	36,743			73,481		130,232	11,867,173	96
March 31, 1971	36,737	39,055	75,892	36,743			73,481		130,232	11,997,405	96
Sept. 30, 1971	36,737										

Sources: House Production, Slum Clearance, etc., England and Wales, Ministry of Health Annual Reports and other information.

to be done before a satisfactory standard is reached. Reserving discussion on this point to Part III, we proceed on the basis of what exists.

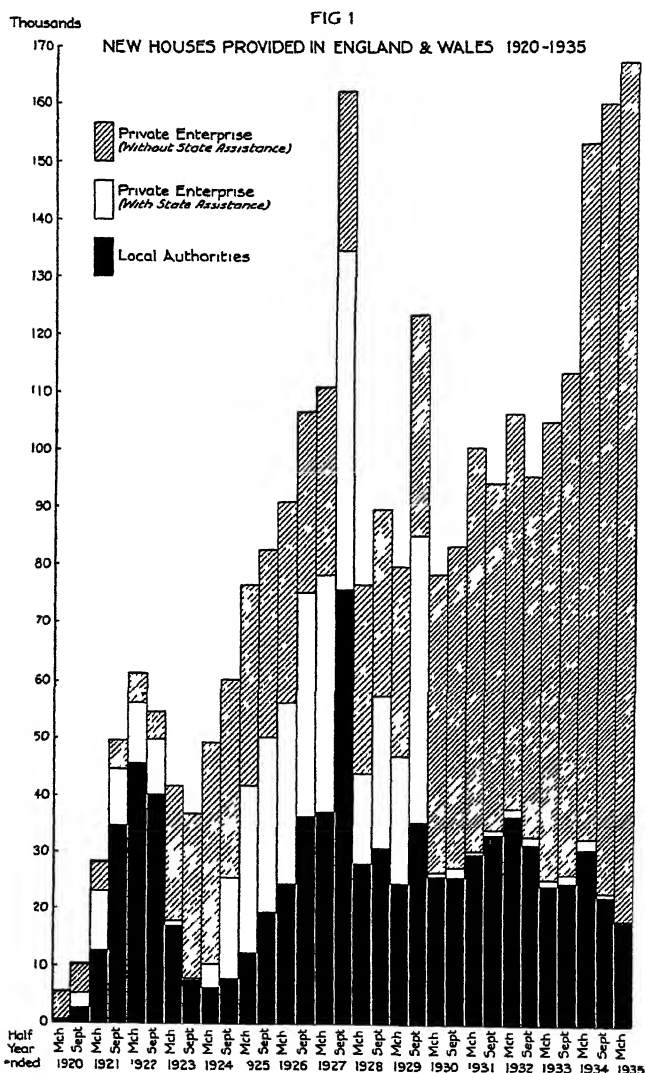


Table I shows the total number of houses provided in England and Wales since the Armistice, with insignificant omissions, distinguishing public and private enterprise and assisted and non-

assisted housing. There is no analysis by types and sizes, but there is a rudimentary analysis by rateable values (see Table II below). Col. (11) provides an easy means of finding the total number of houses built between any two dates. Col. (12) depends upon data known to be imperfect, and should only be accepted as a rough guide.

The salient features of Table I are shown in Fig. 1.

In reading this figure it should be noted (a) that the return for the half-year ended March 1920 includes a few houses completed before Sept. 1919, and (b) that the returns relate to the half-years in which the houses were *completed*.

Municipal building rose under the stimulus of the 1919 subsidies to a peak of 80,000 houses in 1922, followed by a slump due to limitation of commitments. The Acts of 1923 and 1924 (more particularly the latter) gave a new stimulus, exaggerated in 1928 by building in anticipation of the reduction of subsidies from October 1927. Thence municipal building kept fairly steady at the 60,000 level, but fell to 40,000 owing to the withdrawal of the 1923 and 1924 subsidies. The effect of the 1930 Act is not marked, since it took some time before it was put into effective operation.

Private enterprise with State assistance rose to 20,000 houses in 1922, and then fell owing to the withdrawal of the subsidies. Stimulated by the Acts of 1923 and 1924, it rose nearly to the 80,000 level in 1927, fell again with the reduction of the subsidies and disappeared with their withdrawal.

Private enterprise without State assistance was stimulated by the withdrawal of the 1919 subsidies, held in check at the 65,000 level by the subsidies of 1923 and 1924, rose to 130,000 in 1932 with the disappearance of competition due to subsidized private enterprise, and rose again to a record figure of 285,000 in 1935 as a result of the final withdrawal of subsidies for new building and the stimulus of cheap money.

It appears that the policy of postponing slum clearance and de-crowding and relying upon "filtering up" was pursued too far. It would have been better if housing authorities had concentrated upon these activities at an earlier stage, with the double object of remedying the evils at their source and relieving private enterprise from competition. Control of the position has been hampered from first to last by lack of adequate statistical information. There have been too many changes of policy and administration, and the load upon the building industry has been badly spread. Opportunities of coming to a definite arrangement with the Building Industry were not exploited as they deserved.* There is good reason

* "If local authorities, builders, operatives and manufacturers of building

TABLE II.

New Houses Provided in England and Wales 1919-35.

(This Statement does not include 14,601 houses provided to rehouse persons displaced under Improvement and Reconstruction Schemes made under the Housing of the Working Classes Act, 1890, and the Housing Act, 1925.)

	Number of Houses provided up to March 31, 1935.			
	By Local Authorities.	By Private Enterprise.	Total.	Total in Rural Districts * (included in previous column).
<i>With State Assistance—</i>				
Housing, Town Planning, etc., Act, 1919 ...	170,090	4,545	174,635	35,915
Housing (Additional Powers) Act, 1919 ...	—	39,186	39,186	15,979
Housing, etc., Act, 1923 ...	75,309	362,738	438,047	118,261
Housing (Financial Provisions) Act, 1924:—				
(a) In Agricultural Parishes ...	29,444	2,062	31,506	30,114
(b) In other Parishes ...	475,074	13,718	488,792	36,833
Housing Act, 1930:—				
(a) In Agricultural Parishes ...	631	—	631	581
(b) In other Parishes ...	40,145	455	40,600	577
Totals (Assisted) ...	790,693	422,704	1,213,397	238,260
<i>Without State Assistance with a rateable value—</i>				
(a) Up to £26 (£35 in Greater London) ...	16,587	1,150,300	1,166,887	318,764
(b) £27 to £52 (£36 to £70 in Greater London) ...	148	245,924	246,072	39,899
(c) £53 to £78 (£71 to £105 in Greater London) ...	40	29,506	29,546	4,837
Totals (Unassisted) ...	16,775	1,425,730	1,442,505	363,500
Grand Totals ...	807,468	1,848,434	2,655,902	601,760

Source: House Production, Slum Clearance, etc., England and Wales.

* Many houses which were provided in rural districts are now in urban districts, mainly owing to alterations in areas made as a result of the County Reviews under the Local Government Act, 1929. The figures in the last column relate to rural districts as now constituted except those in respect of houses provided under the Acts of 1919, 1923 and 1924, which relate to districts which were rural districts when the final returns under those Acts were made.

materials could have been assured of a continuous demand for their services and products for a good period of years, difficulties about supplies of labour and materials would probably have not existed. In the absence of some guarantee, operatives will not agree to dilution or further augmentation of numbers, and manufacturers of *e.g.* bricks will not extend their works." (Letter from a correspondent, 14th October, 1935.)

for supposing that legislative and departmental control upon traditional lines has not proved an unqualified success, and that the problem would have been solved more cheaply and expeditiously if Parliament had laid down a broad policy, granted an annual appropriation, and appointed a Commission to work out a long-term programme aiming at continuous and economical employment of national resources.

An analysis of the total number of houses provided up to 31st March, 1935, with State assistance under the various Acts and without State assistance, in broad grades of rateable value, is given in Table II.

While it may be safely assumed that the large majority of houses provided with State assistance fell in the grade up to £26 (£35 in Greater London) rateable value, the analysis is not fine enough to throw light on the adequacy of the provision made for lower-paid workers. A finer analysis is available in respect of houses provided by private enterprise without State assistance beginning with the half-year ending 31st March, 1934, but it does not go back far enough to make a useful contribution to the problem.

Table III is designed to throw light upon the relations of supply and demand over the period 1911-41. Only rough comparisons are possible, and it is simpler to deal with houses and families than with persons and rooms. Supply is taken to be equivalent to the total stock of structurally separate dwellings as returned at each census, and inter-censal movements are found by differences. Demand for housing accommodation is a vague term, partly because the number of "families" returned in the census includes an unknown proportion of groups not desiring separate accommodation, and partly because there is an unknown number of potential "families" that would come into existence were an unlimited supply of accommodation available at low rents. Since the vast majority of single-person "families" represent the lodger type, the best plan is to base the index of demand on the number of private "families" of 2 persons or more. Figures of total population (of which 5 per cent. do not live in private families) and total private families are given for purposes of comparison. Col. (11) shows the estimated cost of working-class housing at the respective census dates.

Upon this basis a comparison of the indices in Cols. (4) and (10) registers the relative shortage or excess, taking the 1911 position as standard. The relevant figures are as follows :

Census Date.						Supply Demand	Index.
1911	100
1921	95
1931	94
1941	105

TABLE III.
England and Wales—Dwellings, Population and Private Families, 1911-1941.

(In thousands.)

Census Date.	Item.	Total Structurally Separate Dwellings.		Total Population.		Total Private Families.		Total Private Families, 2 Persons or More.		Estimated Cost of Working-class Housing.
		No. (3)	Index. (4)	No. (5)	Index. (6)	No. (7)	Index. (8)	No. (9)	Index. (10)	
1911	No. of structurally separate dwellings (as estimated)	7,691	100.0	36,070	100.0	7,943	100.0	7,320	100.0	67
	Inter-censal increase (net)	288	3.7	1,818	5.0	796	10.0	692	9.5	133
1921	No. of structurally separate dwellings (as recorded)	7,970	103.7	37,885	105.0	8,739	110.0	8,012	109.5	200
	Inter-censal increase (net) viz. : New houses provided									
	Less demolitions, conversions, etc. (net)	1,421	18.5	2,063	5.8	1,494	18.8	1,532	20.9	100
1931	No. of structurally separate dwellings (as recorded)	9,400	122.2	39,948	110.8	10,233	128.8	9,544	130.4	100
	New houses provided									
	Less demolitions, conversions, etc. (net)	2,000	26.0	1,052	2.9	917	11.6	803	10.9	...
1941	No. of structurally separate dwellings (as forecast)	11,400	148.2	41,000†	113.7	11,150‡	140.4	10,947‡	141.3	...

Source : Census of 1931 : Housing ; and Table I (below).

* Based on rate of progress during the period 1931-35, i.e. $\frac{10}{4} \times 995 = 2500$ (say).

† Assuming 300,000 houses are demolished under slum-clearance schemes and 200,000 disappear for other reasons.

‡ Based on Registrar-General's estimates : Census of England and Wales : Housing, Part IV.

The position in 1921 was actually worse than that shown by the census figures, since pressure upon accommodation in that year had produced an artificial restriction in the number of families.* The index for 1921 was therefore too high and the improvement in 1931 is actually greater than appears.

It is assumed for purposes of illustration that the average rate of building progress shown during the 4 years 1931-35 will be maintained over the whole decennium, that 300,000 houses will be demolished under slum-clearance schemes and that a further 200,000 will disappear for other reasons, and upon this basis the total number of houses will by 1941 exceed the total number of families. Apart from local shortages every family needing a separate dwelling will have one if they can afford it; there will be a margin for empty dwellings and another margin for contingencies.† At this rate there will be an early slump in the building industry unless it should be decided to raise minimum standards of accommodation to a much higher level or to carry out large-scale reconstruction schemes.

Table IV shows the aggregate expenditure and income of local authorities in England and Wales in respect of housing for the financial year ending 31st March, 1933.

Table IV is difficult to interpret for the following reasons :

(1) The entries relating to the Act of 1919 relate solely to houses provided by the local authorities, whereas the entries in respect of other State-aided housing schemes relate to (a) houses provided by local authorities under Acts subsequent to 1919; (b) annual loan charges in respect of lump sum payments made by local authorities to private enterprise and the annual Government grants in connection therewith, and (c) assistance given by local authorities to private owners for the conversion or adaptation of existing houses (Housing Rural Workers Acts, 1926 and 1931).

(2) The practice of local authorities in compiling their returns varies. Some only show the net rent received as " specific income," whereas others show a gross rent inclusive of rates, etc., the transfer of the excess over the net rent being entered as expenditure under " maintenance, etc."

(3) The capital monies were repayable over varying periods, and no attempt has been made to work out the equated time. Consequently it is impossible to say precisely what is the average rate of interest involved.

* *Census of England and Wales : Housing*, p. xix.

† According to the Registrar-General, a total of 1·7 million new dwellings will be required during the decennium 1931-41 in order to make good losses amongst existing dwellings of all kinds; to provide for the likely requirements of all new families; to provide additional accommodation for sharing families and to replenish the reservoir of vacants. *Ibid.*, p. lxi.

TABLE IV.

*England and Wales—Aggregate Expenditure and Income of Local Authorities on Housing and Outstanding Loan Debt.
Year ending 31st March, 1933.*

Item. (1)	Housing.			Small Dwellings Acquisition. (5)
	Assisted Schemes under Housing etc. Act, 1919. (2)	Other State-aided Housing Schemes. (3)	Other Housing Schemes. (4)	
Revenue Account:—	£'000.	£'000.	£'000.	£'000.
Expenditure—				
Maintenance and other expenses not being loan charges	2,407 (17·8)	7,485 (31·7)	940 (51·6)	263 (10·0)
Loan Charges	11,142 (82·2)	16,145 (68·3)	880 (48·4)	2,363 (90·0)
Total	13,549 (100·0)	23,630 (100·0)	1,820 (100·0)	2,626 (100·0)
Specific Income—				
Rents, etc.	5,820 (43·0)	15,913 (67·4)	1,594 (87·6)	2,633 (100·3)
Government grants ...	6,601 (48·7)	6,128 (25·9)	2 (0·1)	—
Balance of Expenditure not met out of specific income	1,128 (8·3)	1,589 (6·7)	224 (12·3)	Cr 7 Cr (0·3)
Capital Account:—				
Capital Receipts during year—				
From loans	107	22,691	682	2,562
Sums transferred from Revenue and from special funds	21	208	81	32
From Government grants, sales of land and other sources	114	619	117	5,211
Total	242	23,519	880	7,805
Capital Expenditure dur- ing the year	130	20,255	811	7,386
Gross outstanding loan debt at end of year ...	170,700	279,561	16,499	47,215

Source: Local Taxation Returns, as summarized by Ministry of Health.
Sixteenth Annual Report of Ministry of Health, 1934-35 (Cmd. 4978), pp. 314-315.

TABLE V.
England and Wales—Exchequer Contributions in Respect of Housing Schemes. 1932-33 and 1934-35.

Financial Year.	Item.	Housing, Town Planning, etc., Act, 1919.	Housing (Additional Towers) Act, 1919.	Housing Act, 1923.	Housing (Financial Provisions) Act, 1924.	Housing (Mutual Workers) Acts, 1926 and 1931.	Housing Act, 1930.	Totals.
1932-33	No. of houses (completed by the end of financial year) towards the expenses of which Exchequer contributions were made ... ..							.
	Amount of Exchequer contributions paid in financial year (£'000)... ..	174,635	39,186	438,047	460,718	5,787	8,491	1,126,864
		6,781	—	2,634	3,873	11	50	13,350
1934-35	No. of houses (completed by the end of financial year) towards the expenses of which Exchequer contributions were made							
	Amount of Exchequer contributions paid in financial year (£'000)... ..	174,635	39,186	438,047	520,298	8,280	41,231	1,221,677
		6,671	—	2,500	4,264	20	303	13,758

Source : Ministry of Health Annual Reports.

The Exchequer is saddled with a heavy burden, more than half of which relates to early schemes which were carried through at high prices and high interest rates, and which cover only one seventh of the houses provided with State Assistance. As regards the burden

TABLE VI.

Housing Act, 1930. Statement as to the Number of Dwelling-houses Demolished or Closed under the Act, the Number of Persons Displaced, and the Number of Dwelling-houses Made Fit.

	During the Half-year ending March 31, 1935.	Up to March 31, 1935.
CLEARANCE AREAS :—		
1. Houses demolished	7,342	20,444
2. Persons displaced	32,279	96,429
IMPROVEMENT AREAS :—		
3. Houses demolished	68	324
4. Persons displaced—		
(a) by demolition of houses	368	1,417
(b) to abate overcrowding	767	1,597
5. Houses made fit	115	560
INDIVIDUAL UNFIT HOUSES :—		
6. Houses demolished as a result of—		
(a) formal procedure under the Act	4,314	19,037
(b) informal notices preliminary to formal procedure	909	3,994
7. Parts of buildings closed	709	3,005
8. Persons displaced (from houses demolished as a result of formal procedure under the Act or in part closed)	17,790	78,347
9. Houses in respect of which undertakings not to use for human habitation were given	753	5,033
10. Houses made fit as the result of—		
(a) formal procedure under the Act	11,083	103,113
(b) informal notices preliminary to formal procedure	38,366	257,075
TOTAL :—		
11. Houses demolished, closed or not to be used for human habitation	14,095	51,837
12. Persons displaced as a result of formal procedure under the Act	51,204	177,790
13. Houses made fit as a result of formal procedure under the Act	11,198	103,673

Source : House Production, Slum Clearance, etc., England and Wales.

on the ratepayers, the balance of expenditure not met out of specific income is relatively small, being only a quarter of the direct Exchequer contribution, and this balance falls on the block grant under the Local Government 1929 as well as on rates. The precise extent of the expenditure falling on rates is of course unknown, since the block

grant is applied in relief of local expenditure generally, and not of specific services.

Table V gives particulars of Exchequer contributions in 1932–33 and also in 1934–35. The discrepancies between the figures in this and the preceding table are due mainly to accounting reasons.

TABLE VII.

Advances and Guarantees by Local Authorities since the 1st January, 1919.

	Number of Houses in Respect of which Advances have been made or Guarantees given.		Amount of Advances.	
	During the Half-year ending March 31, 1935.	Total up to March 31, 1935.	During the Half-year ending March 31, 1935.	Total up to March 31, 1935.
ADVANCES under :—			£	£
(1) Small Dwellings Acquisition Acts ...	4,654	117,550	2,043,383	58,835,100
(2) Section 92 of the Housing Act, 1925 ...	899	57,763	378,860	26,646,603
Totals ...	5,553	175,313	2,422,243	85,481,703
GUARANTEES under :—				
(1) Section 92 of the Housing Act, 1925 ...	1,621	26,040		
(2) Section 2 of the Housing (Financial Provisions) Act, 1933 ...	3,181	5,537		

The houses included in this Table are also included in the appropriate part of Table II when they are completed. For the purposes of the latter Table, houses in respect of which guarantees have been given by local authorities under Section 2 of the Housing (Financial Provisions) Act, 1933, are regarded as having been provided without State assistance.

Source: House Production, Slum Clearance, etc., England and Wales.

Table VI illustrates progress under the Housing Act, 1930, which now provides the main instrument for improvement of bad housing. Owing to omission of activities under other Housing Acts and under the Public Health Acts, the picture given is not complete.

Table VII refers to advances and guarantees given by local authorities, and does not call for special comment.

PART II—STATISTICAL ASPECTS OF HOUSING.

(5) *Existing Sources.**

Provision for collection and publication of statistical and other data bearing on Housing falls under the following heads :—

- (1) Population Census : Summary Tables.
- (2) Local authorities' inspection records (for internal use only).
- (3) Annual Report of Ministry of Health ; Summary Tables :
 - (a) Cost of new houses provided by public enterprise ;
 - (b) Exchequer contributions on account of Housing Schemes ;
 - (c) Numbers of houses rendered fit as a result of action under Housing Acts, etc.
 - (d) Expenditure and income of local authorities classified according to services.
- (4) Bi-annual statement of House Production, Slum Clearance, etc. : Summary Tables :
 - (a) Number of houses provided since Armistice, distinguishing public and private enterprise ;
 - (b) Number provided each half-year during past five years, distinguishing between public and private enterprise and subsidized and unsubsidized building ;
 - (c) Resolutions declaring clearance or improvement areas ;
 - (d) Clearance and compulsory-purchase orders made ;
 - (e) Numbers of dwellings demolished or closed under Housing Act, 1930, and numbers of persons displaced and number of dwelling-houses made fit ;
 - (f) General summary of provision for re-housing accommodation ;
 - (g) Advances and guarantees by local authorities ;
 - (h) Number of houses provided, by areas, during last half-year, distinguishing public and private enterprise.
- (5) Valuation lists.
(Useful as a framework for other information.)
- (6) Electoral Registers.
(Useful as a basis for inspection visits, but not otherwise.)
- (7) Records of Inland Revenue Department.
(Results no longer published in any useful form.)
- (8) Indices of wage rates (compiled by Ministry of Labour) and of prices of building materials (compiled by Board of Trade).

* *Census of England and Wales, 1931 : Housing Report and Tables ; Annual Report of Ministry of Health ; House Production, Slum Clearance, etc., England and Wales ; Ministry of Labour Gazette ; Board of Trade Journal ; Abstract of Labour Statistics for the United Kingdom ; Statistical Abstract for the United Kingdom ; New Survey of London Life and Labour ; Social Survey of Merseyside ; Building Industries National Council Monthly Bulletins.*

- (9) Index of Production in Building Trades (compiled by Board of Trade).
- (10) Statistics of Building Plans approved in 146 towns (compiled by Ministry of Labour).
- (13) Statistics of Employment in Building Industry (compiled by Ministry of Labour).
- (12) Annual Reports of Local Authorities (if published).
- (13) London and Merseyside Social Surveys.
- (14) Building Industries National Council Monthly Bulletin.

A comprehensive investigation into the theory and practice of compiling housing statistics was made a few years ago by the International Labour Office.* It is not the aim of this paper, however, to deal with general methodology, and those interested are referred to the original report.

(6) *Report of the Council for Research on Housing Construction.*

In 1934 the whole question was taken up by the *Council for Research on Housing Construction*, whose report, published in January 1935,† whilst indulgent towards the lapses of the past, drew clear attention to the inadequacy of the existing arrangements and made out a strong case for a comprehensive survey of housing conditions according to definite standards.

A summary of Conclusions and Recommendations appended to the Report is printed below. Some of these will be discussed at a later stage of this paper.

Housing Standards and Statistics: The Second Report of the Council for Research on Housing Construction.

Summary of Conclusions and Recommendations.‡

The Need for a National Housing Survey.

1. The determination of housing policy is seriously hindered, and the accurate estimation of national and local housing needs is made impossible, by the lack of adequate statistical information on housing conditions. More serious still is the lack of clearly defined and nationally accepted minimum standards for housing,

* *Methods of Compiling Housing Statistics*, Geneva, 1928.

† *Housing Standards and Statistics: the Second Report of the Council for Research on Housing Construction*. This Report was drafted by a technical panel of eight members acting in a consultative capacity, of whom five are Fellows of this Society, viz.: Dr. W. H. Coates (Chairman), Messrs. L. R. Connor, J. E. Highton, D. Caradog Jones and J. C. Spensley. The other members were Messrs. John Dower (architect), H. H. George (Ministry of Health), and L. H. Keay (Director of Housing, Liverpool). Messrs. George and Highton acted as unofficial observers for the Ministry of Health and the Department of Health for Scotland respectively. The responsibility for the conclusions and recommendations falls on the Council.

‡ The figures in parentheses refer to the pages of the original report.

without which mere statistics are not of much practical use. The determination of standards and the improvement of statistics are matters of urgent and vital importance (p. 10).

2. To remedy this lack of information, more especially in view of the forthcoming campaign against overcrowding, it is essential that a national housing survey, based on national housing standards, should be organized and put into operation at the earliest possible date (pp. 12-15).

Existing Housing Information.

3. The population census, while admirably conceived for the general statistical purposes for which it is intended, is fundamentally unsuitable for use as a housing survey, since (i) it cannot be kept continuously revised, (ii) its publication is necessarily delayed, and (iii) it can only relate to facts easily ascertained and numerically expressed (pp. 20-22).

4. Nevertheless the census is a very valuable record of the nation's housing as related to its other statistical characteristics: for housing as well as for other purposes, the census should be converted from a decennial to a quinquennial basis, beginning with the year 1936 (pp. 22-23).

5. The statutory records of housing conditions and activities at present kept by local authorities, though voluminous, are incomplete, inaccessible, out-of-date in form and, lacking the basis of nationally accepted standards, ineffective. It will be cheaper and more expeditious to start a fresh survey system than to attempt a compilation from existing records (pp. 30-31).

National Housing Standards.

6. The broad purpose of housing standards should be to provide a line of division between "satisfactory" and "unsatisfactory" in housing conditions. The line of division should (i) be precise, (ii) comprehend all the relevant features of a dwelling, its occupation and its surroundings, (iii) express, so far as possible, a collective judgment, not a series of varying individual judgments, and (iv) be so framed as to facilitate the raising of standards, as national or local circumstances may permit (pp. 32-34).

7. A clear distinction must be made between the two main categories of housing standards: (i) those concerned with the *occupation* of dwellings, for the prevention of overcrowding, and (ii) those concerned with the *fitness and equipment* of dwellings, for the prevention of slum conditions (p. 32).

Standards of Occupation.

8. A satisfactory standard of occupation involves the assessment of (i) the accommodation available in each dwelling according to the number and size of its habitable rooms, and (ii) the accommodation required by each occupying family according to the number, ages, etc., of its members. None of the accommodation standards which have so far been used or proposed makes adequate provision for both these elements (p. 38).

9. A new standard of occupation is recommended, which would determine by suitable tables the number of "units of accommodation" (i) available in each dwelling, and (ii) required by each family according to the number of "equivalent adults" therein; the extent of any overcrowding being measured by the excess of (ii) over (i) (pp. 38-41).

10. The new standard of occupation would be used as a basis for (i) action against individual cases of overcrowding, and (ii) estimation of the shortage of housing accommodation in each administrative area (pp. 42-43).

Standards of Equipment and Fitness.

11. Existing standards of equipment and fitness are of purely local and widely varying application. Though many points of detail, more especially as regards the availability of services, must remain matters for local regulation, the basic requirements for any habitable dwelling should be nationally defined: suitable standards are recommended (pp. 43, 46 and 47).

The National Housing Survey.

12. It is recommended that the national housing survey, though operated by the local authority in each administrative area, should be conducted on a uniform plan for the whole country under the general direction of the Minister of Health (pp. 48-59). [*Detailed proposals omitted.*]

Housing Statistics.

13. It is recommended that a new and comprehensive system of returns should be worked out from the survey by each local authority and submitted periodically to the Minister of Health (pp. 59-66). [*Detailed proposals omitted.*]

Codification of Local Authorities' Powers.

14. Action by local authorities for the improvement of housing conditions is seriously hampered and confused by out-of-date and unco-ordinated laws and by-laws; a general codification and revision according to a uniform system, corresponding to modern housing standards and administrative methods, is recommended (p. 29).

The report included Table VIII, which contrasted the information required with that actually obtainable.

Section B of this Table must be read in the light of the new returns required under the Act of 1935. Model forms of return have been published. Full particulars will only be obtained in respect of houses at which there is *prima facie* evidence of overcrowding.*

* See Housing Act 1935, Memorandum B: the Prevention and Abatement of Overcrowding.

(7) *Local Authorities' Housing Records.*

A digest of the existing Regulations regarding local authorities' housing records has been omitted on account of pressure on space. Those interested are referred to the summary given in the Council's report.*

(8) *Summary.*

To summarize the position to date :

(1) The Ministry of Health publish a considerable amount of crude statistical information, sufficient to show in broad terms the total volume of activities of various kinds and in some cases where they exist. There is, however, no attempt to co-ordinate this information and display it as a coherent whole, nor to submit it to critical analysis nor to set up standards by which activities might be judged.

(2) There are sundry omissions of which the following may be noted :

- (a) Statistics of demolitions, conversions and adaptations; †
- (b) Analysis of housing accommodation according to type, accommodation, rent or rateable value;
- (c) Tenants' rents and means to pay.

(3) The nation's stock of houses and the distribution of population among dwellings and rooms is only known at decennial intervals, and while statutory provision exists for the holding of a quinquennial population census in Great Britain (Census Act, 1920, s. 1), efforts to induce the Government to act have proved unsuccessful.‡

(4) No authoritative statistics of overcrowding exist at present, but the omission will be made good under the Act of 1935. §

(5) Records of unfit houses exist, but are not based upon comprehensive surveys nor upon uniform standards. There is no attempt to fit them into the general framework of information.

The remedy consists in the setting up of an expert Sub-Committee of the *Central Housing Advisory Committee* with instructions to go into the whole question and consider the proposals put forward by the *Council for Research on Housing Construction* and other bodies.

* *Housing Standards and Statistics*, Chapter III.

† See, however, Mr. Vivian's remark on p. 54.

‡ See "Memorandum regarding a Quinquennial Census," *Jour. Roy. Statist. Soc.*, Vol. XCVIII, 1935, pp. 523-530.

§ This remark applies to individual houses. See Mr. Vivian's comment on p. 55.

TABLE VIII.
*England and Wales—Housing Conditions: Summary of Information Available.**

Item.	(1)	Can an Officially Authorized Person obtain Detailed Information concerning any Specified Dwelling without Visiting the Dwelling?	(2)	Is the Information Available to the Public in Convenient Summary Form?	(3)	Original Source of Information.	(4)	Remarks.
A. GENERAL:—								
1. (a) Separate premises:—
2. (b) "Structurally separate dwelling"
3. (c) Tenancy (letting)
(c) Family or "unit of occupation"
4. New house or dwelling
5. Demolition
6. Conversion of premises or house
B. OCCUPATION STANDARDS:—								
1. Number
2. Purpose
3. Dimensions
Persons:—								
4. Sex
5. Age
6. Relationship
C. EQUIPMENT STANDARDS:—								
Specific items
D. FITNESS STANDARDS:—								
1. Repair
2. Sanitation
E. RENT:—								
1. Amount
2. Control

* *Housing Standards and Statistics*, Appendix II, p. 72.

† Denotes that the information is available only at decennial (or quinquennial) intervals. Moreover, the Census Schedules are confidential and an Act of Parliament could probably be necessary to make them individually available for disclosure.

PART III—SPECIFIC TOPICS.

(9) *Housing Surveys.*

Since the breakdown of the national housing survey of 1919 and the repeal of the Act of that year, no steps were taken with a view to ascertaining the true position until 1933, when returns of slum-clearance proposals were obtained from local authorities and the minimum extent of the slum problem became known. These returns were made upon no uniform plan and with no adherence to definite standards, and the *Council for Research on Housing Construction* advance grave reasons for suspecting they are incomplete.* A complementary survey dealing with overcrowding will follow under the new Act, but when the Council and their associates represented through appropriate channels that the survey should be made comprehensive so as to cover all classes of dwellings and all causes of complaint, they were met with a refusal on the ground that the proposal was unnecessary and would lead to delay.†

(10) *Working-Class Housing.*

Action under Parts I and III of the principal Act is confined to "working-class" houses, but no similar restriction exists with regard to Part II (Unhealthy Areas). There is no statutory definition of the term "working class" of general application, and the courts construe it in its "natural and ordinary sense." A house is "working class" within the meaning of the Acts if it is either occupied by members of the working classes or of a type suitable for such occupation. Thus there is room for considerable latitude, and it is the practice of local authorities to vary the definition according to the particular purpose for which it is required. It is claimed that the present arrangement gives satisfaction and that there would be no advantage in seeking a statutory definition.‡ Were a national survey of housing conditions instituted, it would be necessary to abolish the distinction, at any rate as far as the survey arrangements went, the more so as it is out of keeping with modern ideas.§

(11) *Overcrowding Scale—Existing Houses.*

Prior to the passage of the 1935 Act, local authorities had no general powers of action against overcrowding as such. They might

* *Housing Standards and Statistics*, p. 14.

† For the arguments used on both sides, see *Housing Standards and Statistics*, Chapters I, II and V, and Parliamentary Debates, House of Commons, Standing Committee A, Feb. 12, 1935, cols. 18-20; House of Lords, June 24, 1935, cols. 681-689.

‡ Parliamentary Debates, House of Commons Standing Committee A, Feb. 26, 1935, cols. 157-165; House of Lords, June 24, 1935, cols. 681-689.

§ In Scotland there is a valuation test defined at £45. This covers well over 90 per cent. of occupied houses.

make by-laws under the Act of 1925 for fixing "the number of persons who may occupy a house which is let in lodgings or occupied by members of more than one family and for separation of the sexes therein" (H. A., 1925, s. 6); and if they had declared an improvement area, they might make by-laws for preventing and abating overcrowding, with no restriction upon type of dwelling or its inmates (H. A., 1930, s. 8). Without making by-laws they might proceed under the Public Health Acts, but in that case the house must be so overcrowded as to be "dangerous or injurious to the health of the inmates," i.e. conditions must be aggravated. Thus, overcrowding was an offence, but it was impossible to take effective large-scale action, partly because of legislative weakness, but mainly because of the difficulty of providing alternative accommodation. The new Act lays down a definite scale generally applicable to "working-class" houses, and, subject to certain saving provisions, makes any infringement of the scale a penal offence (H. A., 1935, ss. 2, 3, etc.).

The scales laid down by the Act are as follows:—

Definition of Overcrowding.

(1) A dwelling-house shall be deemed for the purpose of this Act to be overcrowded at any time when the number of persons sleeping in the house either—

- (a) is such that any two of those persons, being persons ten years old or more of opposite sexes and not being persons living together as husband and wife, must sleep in the same room, or
- (b) is, in relation to the number and floor area of the rooms of which the house consists, in excess of the permitted number of persons as defined in the First Schedule to this Act.

(2) In determining for the purposes of this section the number of persons sleeping in a house, no account shall be taken of a child under one year old, and a child who has attained one year and is under ten years old shall be reckoned as one-half of a unit (H. A., 1935, s. 2).

First Schedule.

Number of Persons Permitted to use a House for Sleeping.

For the purpose of Part I of this Act the expression "the permitted number of persons" means, in relation to any dwelling-house, either—

- (a) the number specified in the second column of Table I in the annex hereto in relation to a house consisting of the number of rooms of which that house consists, or

(b) the aggregate for all the rooms in the house obtained by reckoning, for each room therein of the floor area specified in the first column of Table II in the annex hereto, the number specified in the second column of that Table in relation to that area, whichever is the less :

Provided that in computing for the purposes of the said Table I the number of rooms in a house, no regard shall be had to any room having a floor area of less than 50 square feet.

Annex.

TABLE 1.

Where a house consists of :—

(a) One room	...	...	...	2
(b) Two rooms	...	...	...	3
(c) Three rooms	...	...	...	5
(d) Four rooms	...	...	...	7½
(e) Five rooms or more	...	...	...	10, with an additional 2 in respect of each room in excess of five.

TABLE 2.

Where the floor area of a room is :—

(a) 110 sq. ft. or more	...	...	...	2
(b) 90 sq. ft. or more, but less than 110 sq. ft.	...	...	...	1½
(c) 70 sq. ft. or more, but less than 90 sq. ft.	...	...	...	1
(d) 50 sq. ft. or more, but less than 70 sq. ft.	...	...	...	½
(e) Under 50 sq. ft.	...	...	...	Nil

This section provides three tests of overcrowding—(1) sex separation, (2) rooms per person, (3) floor space per person, and there stops. For calculation purposes every room (including the living-room) is deemed to be occupied, and if the family can then dispose themselves in any way which passes all three tests, there is no "overcrowding." While there is no explicit provision for a separate living-room, the scale is sufficiently generous to enable a normally constituted family of four "persons" or more to set aside one room for that purpose without causing excessive pressure upon the remainder. If the family is not normally constituted or the rooms are awkward in size, such reservation may be impossible, and the scale provides no remedy. The section is silent as to the way in which the rooms are actually used or the family actually dispose themselves. The general design of the scales is simple and ingenious; no room need be measured up unless its apparent floor area is less than 110 sq. ft.; and there is no risk of serious anomalies. Table IX shows the joint effect of the scales in compact form. Assuming it is proposed to put x "persons" in y rooms, it answers the following two questions—

- (1) What combinations of x and y are allowable?
- (2) Assuming the proposed combination is allowable, what must be the aggregate minimum floor area of the habitable rooms?

The Ministry have not disclosed the basis of their calculations, but the following are reasonable deductions from the figures as they stand :

(A) A combination of x and y is allowable in the first instance provided $x \leq 2y$; i.e. there is a maximum overall density of 2

TABLE IX.

Overcrowding Scale—Allowable Combinations of "Persons" and Rooms and Minimum Floor-Area Requirements.

No. of "Persons."	No. of Rooms.					
	1.	2.	3.	4.	5.	6.
	Minimum Floor Area of Habitable Rooms in sq. ft.					
1	70	—	—	—	—	—
1½	90	120.	—	—	—	—
2	110	140	—	—	—	—
2½		160	190	—	—	—
3		180	210	—	—	—
3½			230	260	—	—
4			250	280	—	—
4½			270	300	330	—
5			290	320	350	—
5½				340	370	400
6				360	390	420
6½				380	410	440
7				400	430	460
7½				420	450	480
8					470	500
8½					490	520
9					510	540
9½					530	560
10					550	580
10½						600
11						620
11½						640
12						660
	Irreducible Minimum Floor Area per "Person" in sq. ft.					
	55	60	58	56	55	55

"persons" per room. This test may be compared with the Registrar General's index of the existence of overcrowded conditions.*

(B) In a dwelling of two rooms or more, one room may be set aside partly or wholly for living-room purposes, so improving the quality of the accommodation at the expense of its amount (since no room is now available for use full time). The necessary space is found by increasing the maximum bed-room density to $2\frac{1}{2}$ persons (corresponding with the *Manchester* standard) and ejecting any

* See *Census of England and Wales: Housing*, p. xxvi.

surplus occupants. Upon this basis the allowable number of "persons" is reduced as follows:

Dwellings of 5 rooms or more	...	...	Nil.
" 4 rooms	...	...	From 8 to 7½ "persons."
" 3 "	...	...	" 6 " 5 "
" 2 "	...	...	" 4 " 3 "
" 1 room	...	...	Nil.

In order to apply this test to the two lowest cases, it is necessary to assume that in a two-roomed dwelling half a person sleeps in the living-room, leaving 80 per cent. free, and that in a one-roomed dwelling there is 20 per cent. free.

(C) The rooms may be sufficient in point of number but not in point of size, and here the floor-area test comes in. This is given by the formula—

$$f = 40x + 30y$$

where f = aggregated floor area in sq. ft.

In other words, the minimum floor-area requirement is calculated as 40 sq. ft. per person plus 30 sq. ft. per room, subject to the conventions (i) that in measuring the area of a room a fraction of 20 sq. ft. is ignored, (ii) that rooms of less than 50 sq. ft. are ignored, and (iii) that space in excess of 110 sq. ft. per room is also ignored. This test gives expression to the fact that a small room provides less accommodation in proportion to its size than a medium-sized one, particularly if the door opens inwards, and is calculated to prevent excessive sub-division of rooms. The same argument applies to a large room, owing to loss of privacy. The basic allowance of 40 sq. ft. per "person" may be compared with that of the Ministry of Health *Model By-Laws for Improvement Areas* (now repealed).

Example.—A family of 5 "persons" requires at least 3 rooms with a minimum aggregate area of $5 \times 40 + 3 \times 30 = 290$ sq. ft., and such accommodation could be provided in two ways, viz. 110, 110, 70, or 110, 90, 90 sq. ft. If it is proposed to provide the accommodation in 4 rooms, the minimum aggregate area is raised to $5 \times 40 + 4 \times 30 = 320$ sq. ft. and the accommodation could be provided in five ways, viz.: 110, 110, 50, 50; 110, 90, 70, 50; 110, 70, 70, 70; 90, 90, 90, 50, or 90, 90, 70, 70 sq. ft.

From Table XI we see the irreducible minimum of space is 55 sq. ft. per "person," apportionable as follows:

Minimum bedroom space	...	...	40 sq. ft.
Balance available as living-room space or			
surplus bedroom space	...	...	15 sq. ft.

The last figure may be compared with the allowance of 15 sq. ft. per person for public halls, etc.

The scales have been freely criticized on account of their alleged failure to provide separate living-room accommodation. Such criticisms usually rest upon confusion of thought; for so long as provision is in fact made for a room to be set aside, it does not matter

whether that object is achieved by express words or ensues as a consequence. Were it intended to make sleeping in a living-room a penal offence, the case would be otherwise.* Whether the scales taken in their entirety are adequate to provide decent accommodation, is another matter. Consider, for example, the proposal to allow two persons in one room of 110 sq. ft. To accommodate these persons decently, the room must hold a double bed, a table, a chair, cooking and washing utensils and cupboards for storage of food and clothes. There must also be room for boxes and other belongings. The existence of a scullery, lobby or landing to be used as an overflow place cannot be presumed in houses let off in parts. Few people compelled to live two in a room can afford the extravagance of a folding-bed, and it is submitted that the proposal to pack two persons together with all these objects into a room of this size is unreasonable. According to the writer's calculations, the scales reach only 70 per cent. of the standard appropriate to modern dwellings, and although their object is to define overcrowding as a penal offence, it is submitted that they err on the side of meanness.

At the moment of going into the proof stage, the writer has received a copy of an official memorandum on overcrowding,† containing advice to local authorities regarding the overcrowding survey and model forms of return. The resemblance between the Ministry's proposals and those advocated by the *Council for Research on Housing Construction* is sufficient to afford satisfaction to the latter body. Even if the Ministry are allowing undue latitude to local authorities as regards the scope and methods of the survey, success is certain provided the authorities pay reasonable attention to the Ministry's advice.

(12) *Alternatives to Housing Act Scales.*

Alternatives to the scales provided by the Act have been proposed by the *Council for Research on Housing Construction*, Sir Raymond Unwin and others. The Council's plan ascertains the accommodation of each room by reference to a curve instead of a straight line, and provides every household with a definite allowance of living-room space, also based upon a curve which provides a decreasing allowance per person with increasing size of household. Sir Raymond Unwin's scale provides for the reservation of one room as a living-room in dwellings above a minimum size, coupled with an over-riding provision to secure that the living-room shall be adequate in dimensions. A full discussion of these proposals must be deferred

* For arguments, see Parliamentary Debates, House of Commons, Standing Committee A, Feb. 19, 1935; House of Lords, June 24, 1935.

† Housing Act, 1935: Memorandum B: The Prevention and Abatement of Overcrowding.

to some other occasion. Meanwhile those interested should consult the sources noted below.*

(13) *Standard of Re-housing Accommodation.*

When it is a question of re-housing operations, a higher standard comes into operation with respect to houses provided by the local authority. The Minister must ordinarily treat :

a house containing	as providing accommodation for
2 bedrooms	4 persons †
3 "	5 "
4 "	7 "

(Housing Act, 1930, s. 37, as extended by Housing Act, 1935, ss. 12 and 100). This standard is not held to apply to flats, where the accommodation varies "according to circumstances" (Circ. 1138).

This standard only applies to re-housing as a result of slum clearance, de-crowding, etc., and the Government have now given a specific undertaking that it shall be observed not only in the first instance of re-housing, but also thereafter. It does not apply to new housing provided in pursuance of local authorities' general powers. Incidentally the language of the Acts is far from clear, and has been the source of grave misgivings which have not been fully resolved.‡ Apart from these special provisions, local authorities have complete discretion in fixing standards for their own houses, subject, of course, to the overcrowding provisions of the new Act, and, while generally speaking there has been little to complain of, a few examples of gross overcrowding in Council houses have been brought to light.

(14) *Equipment and Fitness Standards.*

The Council for Research on Housing Construction observed that detailed schedules of items were laid down in the *Manual of Unfit Houses and Unhealthy Areas*; that there was no specific obligation upon local authorities to adopt the recommendations made in the Manual; and that since the document in question is out of print and the Ministry has no apparent intention to reissue, it might be inferred that its authority had lapsed. The machinery of inspection under the Act of 1925 provided for attention to a specific list of items, but not for the observance of any specific standard with respect thereto. The operative provisions of the Act were vague. The authority must ascertain by such inspections whether any dwelling-house is "unfit" for human habitation, and it must take

* *Housing Standards and Statistics*, pp. 38-43; Parliamentary Debates: House of Lords, June 25, 1935.

† This section says nothing about "weighting," so that a child counts as a whole person. In practice the existence of small infants would presumably be ignored.

‡ Parliamentary Debates: House of Lords, June 24, 1935.

action with regard to any *working-class dwelling-house* "in any respect unfit for human habitation." Elsewhere it was laid down that in determining for the purposes of this Act whether a house is fit for human habitation, "regard shall be had to the extent, if any, to which by reason of disrepair or sanitary defects the house falls short of the provisions of any by-laws in operation in the district, or of the general standard of housing accommodation of the working classes in the district." The Act did not say that a house which falls short of the provisions or the standard was to be regarded as unfit; nor that a house which does not fall short was to be regarded as fit. Clearly the effect of the provisions, where they did not stereotype the existing position, was to leave the enforcement of standards to the authorities' entire discretion.

A careful examination of this vague and indeterminate existing system, and of various proposals that had been made for its amendment, forced the Council to the conclusion that a detailed set of national standards of equipment and fitness was not a practical possibility. Almost all the questions concerned were, at the critical point of *application*, matters for individual expert judgment. The possession of a particular article of equipment was less important than that the article concerned should be efficient and sanitary in its condition. The medical officer or other agent of the responsible housing authority must be given a wide discretion to exercise his expert judgment on the particular facts of every case. But there was urgent need for outline standards covering the main heads of equipment and the main items of structural and sanitary condition which required investigation on a uniform national basis.

A draft set of national outline standards (not reprinted here) was appended to these proposals.

The reasons for deprecating attempts to enforce a rigid system of standards are as follows :

- (1) Standards are not independent of environment. Bad conditions are aggravated by high densities, crowded streets, lack of open spaces, baths, etc.
- (2) They must be graded according to locality, *e.g.* in rural areas requirements as to drainage and sanitary arrangements may be safely relaxed.
- (3) Treatment must be different according as the house is to be demolished immediately, patched up for a few years pending demolition or reconditioned in the expectation of further useful life.
- (4) Much depends on the existence of public services, *e.g.* water supply, main drainage, lighting.

Nevertheless it is possible to distinguish broadly between

- (a) primary and general requirements to be applied automatically, and

- (b) secondary and particular requirements to be applied with discretion.

The best way of dealing with requirements of the former type is by means of the by-law system. A new series of model by-laws based on the Act of 1935 has been published. These follow traditional lines, and there is need for considerable extension and amplification. Requirements of the latter type should be dealt with in an official *Manual* for the guidance of local authorities and their officers (substantially a revised and amplified edition of the *Manual of Unfit Houses and Unhealthy Areas*, issued in 1919, and now out of print).^{*} Common defects in working-class houses should be classified, numbered and described. Borrowing an idea from the City of Oxford, each item should be accompanied by a detailed specification of the works required to remedy the defect in question, such specification to be used as the basis of notice to the owner. Sanitary Inspectors, through their professional training and contacts made in the course of their duties, have evolved a code of practice which finds expression in the standard text-books of sanitary administration, and it is believed that the policy of allowing them wide discretion under guidance of the kind indicated is more likely to lead to substantial uniformity in practice than any attempt to impose rigid requirements.

(15) *Central and Local Administration.*

Primary responsibility for the administration of the Acts rests with local housing authorities (borough, urban and rural district councils). The powers of county councils are strictly limited. (In London the responsibility is divided between the County and the Borough Councils.) The Ministry of Health acts in a directive and advisory capacity and, with certain exceptions no longer important, deals solely with local housing authorities. Should a local authority prove obdurate, the Minister may exercise his default powers, but the machinery is slow and cumbrous and in practice is seldom exercised. Since the break-up of the regional system, the Ministry has had to deal with 1716 separate authorities, an arrangement hardly conducive to economy and efficiency. Numerous proposals for reform have been made, including the establishment of a national housing commission, transfer of the Minister's functions to another Minister with more time on his hands, establishment of a national planning authority, reconstitution of Ministry as national planning ministry, establishment of joint housing authorities,

^{*} Attention is drawn to the useful matter contained in Circular No. 71, 1934, of the Department of Health for Scotland (Dec. 26, 1934) regarding inspection of houses and the accompanying memorandum on Standard of Fitness for Human Habitation.

TABLE X.
England and Wales Housing Subsidies—Urban Areas, 1919–35. (Provisions of minor importance are omitted.)

Short Title of Act.	Part of Principal Act, or III.	Exchequer Contribution.		Rate Contribution.		No. of Houses provided under Act up to 31.3.35.	Remarks.
		To whom Payable.	Particulars.	(3)	(4)		
(I)	I, II or III.	Local Housing Authority.	(1)	Estimated annual loss resulting from scheme less produce of penny rate (s. 7). Repealed (H.A., 1923, s. 6).	Estimated Capital Value per House.†	(9)	(10)
Housing, Town Planning, etc., Act, 1919 ("Addison," Act).	I, II or III.	Local Housing Authority.	(1)	Estimated annual loss resulting from scheme less produce of penny rate (s. 7). Repealed (H.A., 1923, s. 6).	Estimated Capital Value per House.†	174,635	In 1921 the Government adopted a policy of limiting commitment.
Housing (Additional Powers) Act, 1919.	III.	Public Utility Society or Housing Trust.	A proportion of sundry loan charges (s. 10). The proportion was 60 per cent. up to March 31, 1927 and 40 per cent. thereafter (S.R. & O., 1924, No. 2).	Nil.	Estimated produce of penny rate.		Rules for determination of rents are contained in Schedule B to the Local Authorities (Assisted Housing) (Amendment) Regulations, 1931 (S.R.O., 1931, No. 1178). Rents subject to Minister's approval (S.R.O., 1925, No. 237).
Housing (Additional Powers) Act, 1919.	III.	Private enterprise.	In respect of houses complying with prescribed conditions (Terminated July, 1931).	£130–160 subsequently reduced to £230–260.	Nil.	39,186	See Col. (4).
Housing Act, 1923 ("Chamberlain" Act).	III.	(1) Local Housing Authority (s. 1).	£6 per house for 20 years. Reduced to £4 in respect of houses not completed before Oct. 1, 1927 (S.R.O., 1926, No. 1586).	£75 reduced to £50.	(1) Balance of loss.		Local authority may assist private enterprise by (1) lump-sum grant, (2) annual grant, or (3) contribution to Building Society payments (s. 2).
		(2) Public Utility Society (s. 3).	Withdrawn in respect of houses not completed before Oct. 1, 1929 (S.R.O., 1928, No. 1089).	Nil.	(2) Nil.		
	I and II.	Local Housing Authority.	Amount not exceeding one-half of estimated annual loss (s. 10) (Repealed H.A., 1930, s. 26).	Balance of loss.		428,017	Special conditions as to type and size. Fixed bath in bathroom to be provided (s. 1).

Housing (Financial Provisions) Act, 1921 ("Wheatley" Act).	III.	(1) Local Housing Authority.	£9 per house for 40 years (£12 10s. if house situated in agricultural parish) (s. 2).	£155 reduced to £129.	(1) Loss on rent to be borne by rates.	(Conditions as to type and size as specified by II. A., 1923. Houses should be let at "Appropriate normal rents" (s. 3), but to this may be added the amount necessary to limit the rate loss to £4 10s. per house (s. 3). In respect of houses completed before Oct. 1st, 1927, or £3 13s. thereafter (S.R. & O., 1926, No. 1586).	520,298	Applies to houses subject to "special conditions" as to subletting rents, etc. (s. 3).
Housing Act, 1930 ("Greenwood" Act).	I and II.	(2) Public Utility Society.	Reduced to £7 10s. (and £11 in respect of houses not completed before Oct. 1st, 1927 (S.R.O., 1926, No. 1586) withdrawn (II. A., 1933, s. 1).		(2) Corresponding provisions.	Total amount of rents not to exceed average annual loss less (1) annual equivalent of Exchequer contribution, (2) Annual equivalent of £3 15s. per house deemed to be provided out of rates for 40 years, all calculated by reference to a period of 40 years, (3) Rent rebates granted at authority's discretion (s. 27). Standard of re-housing accommodation laid down (s. 37).	41,331	Act provides for a 15-year programme.
Housing (Financial Provisions) Act, 1933.	III.	Local Housing Authority.	Annual grant for 40 years based on number of working-class persons necessarily displaced for whom suitable accommodation has been rendered available. (1) Agricultural Parish £2 10s. per person. (2) Other Parishes £2 5s. (3) Clearance areas in buildings of more than 2 storeys or on site costing more than £1000 per acre, £3 10s. (s. 26). Power to grant subsidies under Acts of 1923 and 1924 terminated unless in respect of proposals submitted before Dec. 7, 1932 (s. 7). Undertaking to reimburse not more than one-half any loss sustained under terms of guarantee to Building Society (s. 2).	(1) £193. (2) £174.4 (3) £270.4	The balance subject to col. (3).	Special conditions as to size, etc.		Building Society provides the other third of loss.

TABLE X.—Continued.

Short Title of Act.	Part of Principal Act.*	Exchequer Contribution.		Rate Contribution.			Conditions as to Rents, Sizes of Houses, etc.	No. of Houses provided under Act up to 31.3.35.	Remarks.
		To whom Payable.	Particulars.	Estimated Capital Value per House†	Particulars.	Estimated Capital Value per House†			
(1)	(2)	(3)	(1)	(2)	(6)	(7)	(8)	(9)	(10)
Housing Act, 1935.		Local Housing Authority.	<i>Decrepit and Re-development Schemes.</i> (1) In blocks of flats on sites costing more than £1500 per acre, £2 per flat per annum for 40 years, according to cost of development, per acre; £5 per flat per annum for 20 years (s. 32).	(1) See below. (2) £73 maximum.	A contribution equivalent to one-half the Exchequer contribution (s. 31).	(1) See below. (2) £36 maximum.	Provision is made for consolidation of accounts (ss. 40-50) and limitation of conditions affecting local authorities' houses (ss. 51-53).		

§ Cost of Site as Developed per Acre.			Value of £c.	
			Annual.	Capital Value at 3½ per cent.
Exceeding	Not Exceeding.		£	£
1500	4000	4000	6	133
4000	5000	5000	7	156
5000	6000	6000	8	178
6000	8000	8000	9	200
etc.	etc.	etc.	etc.	etc.

* Viz. Act of 1890 or of 1925, as the case may be.

† Interest taken at 5 per cent. per annum (3½ per cent. in 1935).

‡ Assuming an average of 4·5 persons per house.

transfer of housing responsibilities to re-organized county councils, formation of national housing trust to be run on commercial lines, etc., etc. The Government have declined to listen to these proposals, but have consented to the appointment of a new statutory body, the Central Housing Advisory Committee, with certain powers of initiative.

(16) *Housing Subsidies.*

It has been the practice for the last hundred years for the Exchequer to make contributions—generally known as “grants in aid” towards the cost of local government. There has been much ingenuity in devising systems calculated (a) to encourage economy, (b) to secure adequate control without undue interference, (c) to secure an equitable division of the financial burden and (d) to avoid uncertain liabilities. The most important systems have been :

- (1) Assigned revenues, now discredited.
- (2) Deficit grants, *e.g.* Housing Act, 1919.
- (3) Percentage grants, *e.g.* grants in aid of higher education.
- (4) Unit grants, *e.g.* beet-sugar subsidy.
- (5) Block grants, *e.g.* Local Government Act, 1929.
- (6) Mixtures of Nos. (2), (3) and (4), *e.g.* grants in aid of Elementary Education.

The Central Department exercises control by approval of schemes beforehand, visits by inspectors and audit of accounts. Grants may be cut down or withdrawn if the local authority fail to perform their statutory duties, and items of expenditure considered unnecessary may be disallowed or surcharged. The deficit-grant system is not likely to be adopted unless either it is a question of operating a national service through local agency or there is some grave emergency. It is customary to rely upon the percentage-grant system when costs of service are highly variable or unknown, and the unit-grant system when they can be calculated beforehand with some precision. When a group of services has become stabilized the block-grant system offers attractions as a time- and labour-saving device, and it was regarded with favour by the *Committee on National Expenditure*.*

Table X illustrates the gradual evolution of ideas with regard to housing. The emergency conditions of 1919 were met by a deficit grant to local authorities, a percentage grant to housing trusts, etc., and a lump sum to private persons. In 1923 Parliament went over to a unit grant to local authorities and housing trusts in respect of Part III activities (new housing), whilst retaining the percentage system for Parts I and II. The unit grant was repre-

* *Report of Committee on National Expenditure*, 1931 (Cmd. 3920), p. 220.

sented by a uniform sum per house irrespective of overall cost, (although it might be varied from time to time) and there was no adjustment according to particular requirements. The Act of 1924 increased the amount of the unit grant and spread it over a longer term, whilst subjecting it to "special conditions," but otherwise left things as before. The Act of 1930 extended the unit-grant principle to Part I and Part II activities, and introduced a rudimentary differentiation between high-cost and low-cost schemes. Finally, the Act of 1935 achieved a high degree of flexibility by means of a scale designed to neutralize increments in cost of land after a certain point had been passed.

. Table XI shows typical all-in costs of a non-parlour house at

TABLE XI.
Housing Act, 1923—Costs, Subsidies and Rents.

Item. (1)	Sept., 1923. (2)	Sept., 1924. (3)	Sept., 1925. (4)	Sept., 1926. (5)	Sept., 1927. (6)	Sept., 1928. (7)	Sept., 1929. (8)
	£	£	£	£	£	£	£
Average estimated cost of non-parlour house* ...	362	394	435	441	424	368	339
Add for land, roads and sewers, etc.† ...	70	70	70	70	70	70	70
All-in Cost (gross) ...	432	464	505	511	494	438	409
Present Value of Exchequer contribution‡ ...	75	75	75	75	75	50	50
All-in Cost (net) ...	357	389	430	436	419	388	359
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Weekly equivalent spread over 60-year term\$...	7 3	7 11	8 9	8 10	8 6	7 11	7 4
Add for maintenance, etc....	2 1	2 1	2 1	2 1	2 1	2 1	2 1
Subsidized Rent (excluding Rates) ...	9 4	10 0	10 10	10 11	10 7	10 0	9 5
Weekly equivalent of Subsidy\$...	1 6	1 6	1 6	1 6	1 6	1 0	1 0
Economic Rent (excluding Rates) ...	10 10	11 6	12 4	12 5	12 1	11 0	10 5

* Based on prices of contracts let 6 months earlier. The figures are taken from the *Report of the Committee on Local Expenditure, 1932* (Cmd. 4200), p. 54, supplemented by information given by the Ministry of Health.

† Typical figure assumed by the same Committee.

‡ The contribution was £6 per annum for 20 years, subsequently reduced to £4. This is capitalized on a 5 per cent. basis (12.46 years' purchase).

\$ At 18.93 years' purchase.

annual intervals from 1923 to 1929, the value of the subsidy under the Act of 1923 and the corresponding rents, subsidized and unsubsidized. Assuming, in accordance with the usual practice, that economic rent is based on balancing of income and outgo over a 60-year term, and that interest may be taken at 5 per cent. per annum, the subsidized rent varied between 9s. 4d. and 10s. 11d. (excluding rates). Allowing 3s. for the latter item, the inclusive rent (subsidized)

TABLE XII.
Housing (Financial Provisions) Act, 1924—Costs, Subsidies and Rents.

Item. (1)	Sept., 1924. (2)	Sept., 1925. (3)	Sept., 1926. (4)	Sept., 1927. (5)	Sept., 1928. (6)	Sept., 1929. (7)	Sept., 1930. (8)	Sept., 1931. (9)	Sept., 1932. (10)	Sept., 1933. (11)	Sept., 1934. (12)
Average estimated cost of non-parlour house*	£ 394	£ 435	£ 441	£ 424	£ 368	£ 339	£ 335	£ 349	£ 317	£ 294	£ 286
Add for land, roads and sewers†	70	70	70	70	70	70	70	70	70	70	70
All-in Cost (gross) ...	464	505	511	494	438	409	405	419	387	364	356
Present value of Exchequer plus Rate Contribution ‡	232	232	232	232	193	193	193	193	222	—	—
All-in Cost (net) ...	232	273	279	262	245	216	212	226	165	364	356
Weekly equivalent spread over 60-year terms §	s. d. 4 9	s. d. 5 7	s. d. 5 8	s. d. 5 4	s. d. 5 0	s. d. 4 5	s. d. 4 4	s. d. 4 7	s. d. 2 10	s. d. 6 2	s. d. 6 1
Add for maintenance, etc. ...	2 1	2 1	2 1	2 1	2 1	2 1	2 1	2 1	2 1	2 1	2 1
Subsidized Rent (excluding Rates) ...	6 10	7 8	7 9	7 5	7 1	6 6	6 5	6 8	4 11	8 3	8 2
Weekly equivalent of subsidy §	4 8	4 8	4 8	4 8	3 11	3 11	3 11	3 11	3 9	—	—
Economic Rent (excluding Rates) ...	11 6	12 4	12 5	12 1	11 0	10 5	10 4	10 7	8 6	8 3	8 2

* Based on contracts for prices 6 months earlier.

† Typical figure.

‡ Viz. Exchequer, £9 per annum for 40 years, reduced to £7 10s. Rates, £4 10s. per annum for 40 years, reduced to £3 15s. Total, £13 10s. per annum for 40 years, reduced to £11 5s. These are capitalized on a 5 per cent. basis (17·16 years' purchase) up to 1931, and on a 4 per cent. basis (19·76 years' purchase) in 1932.

§ At 18·93 years' purchase (22·62 years in 1932).

varied between 12s. 4d. and 13s. 11d., a figure that might be afforded by a family with an income of £3 10s. weekly, but hardly by a family with less. This calculation is based on a site cost of £70, a moderate amount for an urban area. For higher site costs the rough working-rule is that £50 on land = 1s. weekly on rent.

Table XII gives the same information for a similar house under the Act of 1924. There was a considerable reduction in the subsidized rent due to a more generous Exchequer contribution and a new rate contribution. The rate of interest is taken at 5 per cent., except in 1932, in which year it is supposed to fall to 4 per cent. The subsidized rent fell from a maximum of 7s. 9d. weekly in 1926 to 4s. 11d. in 1932, exclusive of rates. Allowing 2s. 6d. for the latter item, the inclusive figures were 10s. 3d. and 7s. 5d. On the termination of the subsidy the tenant theoretically had to pay 8s. 2d. (exclusive), and so was put in nearly the same position as in 1926, when he had the advantage of the subsidy.

It is interesting to note that in 1924 the subsidy amounted to 50 per cent. of the estimated all-in cost.

The Government's decision to withdraw the subsidy for new housing has been widely canvassed on the ground that it was based upon typical calculations that left no margin for high land costs and other contingencies. On balance it was a wise one. The subsidy lacked flexibility, it tended to discourage private enterprise at a period in which it was just becoming profitable for the latter to enter the housing field and it diverted resources from slum clearance and de-crowding. What the Government has done is to transfer financial assistance from a less to a greater need, and since the scales under the Acts of 1930 and 1935 are generous and the consolidation of housing accounts compels us to think of financial assistance as a whole, there is no reason for saying local authorities have been badly treated. The subsidies under the Acts of 1930 and 1935 have been fully discussed elsewhere,* and it is not proposed to deal with them now.

(17) *Building Costs—Working-Class Houses.*

The object of this section is to break down the statistics of cost of working-class houses given in Table I into their constituents. Cost of building (C) comprises three items of approximately equal weight: † wages (W); materials (M); and residuals (including overheads and builders' profits) (R); and given indices of building

* *Housing Finance: Report on Subsidies for Re-housing in Urban Areas: the Third Report of the Council for Research on Housing Construction, 1935.*

† On this point, see Mr. Gollop's remarks, p. 59.

wages and prices of building materials, the residuals may be calculated from the formula :

$$R = 3C - (W + M)$$

The set based on this calculation shows the movements of constituent items in relation to one another, but not in relation to any kind of norm. This suggests the calculation of a parallel set based on the formula :

$$R' = 3C' - (W' + M')$$

upon the assumption that the movements of the respective items had followed those of industry in general. The variables W' and M' may be immediately identified with indices of general wages and general prices of industrial materials. In the absence of definite information as to R' , the most plausible assumption is to identify it with the mean of W' and M' , whence $R' = \frac{1}{2}(W' + M') = C'$. We are now in a position to calculate a third set of "normalized" items :

$$R'' = 100 \frac{R}{R'}; \quad C'' = 100 \frac{C}{C'}; \quad W'' = 100 \frac{W}{W'}; \quad M'' = 100 \frac{M}{M'}$$

in which movements common to industry in general are eliminated, and movements particular to the building industry are left over.

For consistency's sake it is desirable to arrange the figures so that the formula is :

$$R'' = 3C'' - (W'' + M'').$$

So long as we use natural numbers, this works only approximately, but it can be made to work exactly if we substitute logarithms for the numbers themselves in the three sets of calculations.

Table XIII is best explained by an example. In 1922 building costs, wages and materials stood at 92 (Col. 2), 110 (Col. 5) and 118 (Col. 8) respectively; and upon this basis the residual (including overheads and profits) stood at 60 (Col. 11).*

At the same time general wages stood at 109 (Col. 6) and general materials at 111 (Col. 9). Their geometric mean is 110, which is inserted in Cols. (3) and (12). Cols. (4), (7) and (10) are then filled in by slide rule and checked up by the formula.† The interpretation of these figures is that in 1922 wages and building materials stood 1 and 6 points respectively above normal. Owing to the termination of the subsidy, builders had to cut their total costs to a level 16 points below normal, and this involved serious losses or diminution of profits, indicated by the residual figure standing 45 points below normal.

* $3 \times \log 92 - (\log 110 + \log 118) = \log 60$.

† The check is : $3 \times \log 84 - (\log 101 + \log 106) = \log 55$.

TABLE XIII.
Analysis of Cost of Working-Class Houses, 1921-1934. Average, 1922-31, = 100.

Year.	Price of New Building (- Total Cost plus Profit).			Wages.			Materials.			Residual (including Overheads and Profit).			Capacity of Building Industry.
	Building. C	General. C'	Building Non- material. C''	Building. W	General. W'	Building Non- material. W''	Building. M	General. M'	Building Non- material. M''	Building. R	General. R'	Building Non- material. R''	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1921	137	137	100	133	137	97	148	137	108	131	137	96	—
1922	92	110	84	110	109	101	118	111	106	60	110	55	—
1923	99	105	94	96	97	99	108	114	95	94	105	90	100
1924	109	109	100	98	99	99	107	119	90	123	109	113	101
1925	113	105	108	101	100	101	104	111	94	137	105	130	106
1926	112	102	110	101	101	100	100	103	97	139	102	136	112
1927	105	99	106	101	100	101	97	98	99	118	99	119	118
1928	95	98	97	100	99	101	94	96	98	91	98	93	120
1929	92	96	96	99	98	101	93	94	99	83	96	86	121
1930	92	90	102	98	97	101	90	83	108	88	90	98	122
1931	92	83	110	96	97	99	88	71	124	92	83	111	126
1932	84	81	104	93	94	99	86	69	125	74	81	91	126
1933	82	81	101	91	93	98	82	71	115	74	81	91	130
1934	83	82	101	90	93	97	84	73	115	76	82	93	136

Sources: Col. (2). See Table.

Cols. (5) and (6). Mr. E. C. Ramsbottom's "Indices of Building Wages and General Wages" respectively (*Jour. Roy. Statist. Soc.*, Vol. XCIII, pp. 647 and 666), supplemented by additional information. The original figures refer to December 31 of each year, and have been adjusted so as to show the average for each year.

Col. (8). Unweighted index of prices of bricks, timber, slates and glass, based on information supplied by Mr. H. Leak of the Board of Trade. (The official index only extends back to 1930.)

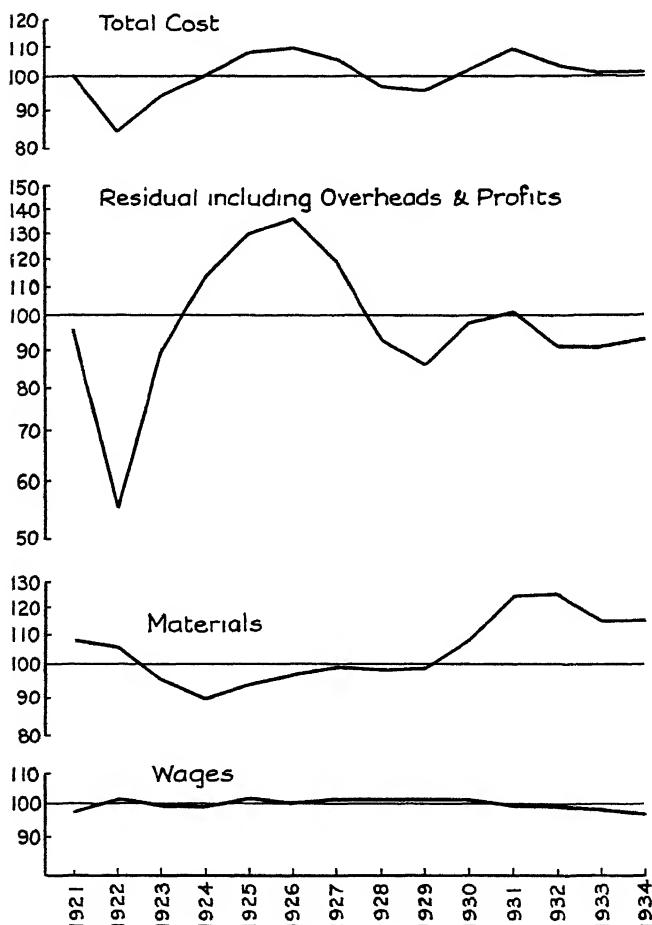
Col. (9). Board of Trade index of wholesale prices of materials (not food).

Col. (14). Index of numbers of persons aged 16-64 insured under the Unemployment Insurance Acts in Great Britain and Northern Ireland. (*21st Abstract of Labour Statistics, 1934* (Cmd. 4625).)

The original figures depended on various bases, and in order to secure comparability they have with the exception of col. (14) been adjusted so as to equate the average of the period 1922-31 to 100.

The general features of the Table are shown in Fig. 2. In reading this figure it should be remembered that the 1919 subsidy was curtailed in 1921; that new subsidies were announced in 1923 and 1924;

FIG 2
ANALYSIS OF NORMALISED COST OF WORKING CLASS HOUSES
1921-1934
Logarithmic Scale



that reductions were announced in 1926; and that their termination was announced in 1928 and 1933 respectively. A further subsidy for slum clearance was announced in 1930 and is still in operation.

The function of a subsidy is to stimulate demand, and upon its

announcement the demand curve for new housing begins to travel from left to right, and the effect upon costs depends upon the shape of the supply curve near the point of intersection. If the building industry is working well below capacity, the supply curve is descending and there is a tendency for costs to fall (or at least not to rise) in face of an increasing supply. With absorption of capacity, however, the supply curve takes an upward turn due to the re-entry of marginal firms and costs tend to rise. At this point a rise is permissible, and indeed necessary, in order to encourage producers to increase capacity. They may be reluctant to do this, arguing that the assistance given by the subsidy is precarious and that shortages of capital, labour and material are to be feared. There are two courses of action open: (1) to come to terms with the industry, the Government undertaking to continue the subsidy and keep pressure upon local authorities to provide more accommodation, the industry undertaking to come to terms internally and increase capacity to an extent commensurate with the new demand; or (2) to reduce the subsidy to a level just sufficient to keep existing capacity fully employed. If course (1) is adopted the Government finds itself involved as a consequence in attempts to control prices of materials; and if it miscalculates or fails in these delicate operations, prices are certain to rise. Let us apply this analysis to Fig. 2.

The curtailment of the 1919 subsidy led to a sudden contraction in demand for new houses, and builders were forced to cut their prices, which by 1922 had fallen 16 per cent. below normal. The resumption of subsidies in 1923-24 led to a sudden expansion of demand which was met in the first instance by a progressive rise in prices, and in the second by an increase in capacity. The latter formed the subject of a bargain between the Ministry and representatives of the building industry in 1924, when it is evident that both parties under-estimated both the intensity of demand and the ability of the industry to cater for it. Capacity was not increased at a rate commensurate with the expansion of demand, and prices continued to rise until 1926, when they stood 10 per cent. above normal. In that year the subsidies were reduced, there was a contraction in demand and prices began to fall again. Meanwhile changes in demand had led to movements in prices of building materials, which fell to a minimum, 10 per cent. below normal, in 1924, and then steadily rose to a maximum of 25 per cent. above normal in 1932. Thus prices of materials showed considerable lag, especially on the upgrade, and since wages hardly changed appreciably, the difference went into builders' profits. In 1931 building prices suddenly rose to a level 10 per cent. above normal, due this time to the maintenance

of sterling prices on a falling market for goods in general. Meanwhile there had been a contraction in demand due to limitation of State-assisted housing, and prices soon dropped towards normal. The termination of the 1924 subsidy in 1933 had little effect upon building prices because the loss on the subsidy was compensated by cheaper money.

Reviewing the situation, it appears that a serious miscalculation was made in 1924, when the subsidy was fixed at a level higher than that warranted by the building industry's undertaking to increase capacity. The corollary of controlling prices of building materials was dropped, and it was decided merely to keep a watch on the situation. For a time all appeared to go well, but the watchers were misled by the fact that prices of materials, although continuing to fall in sterling value, had begun to rise in terms of prices in general. The decision to terminate the subsidy for new building in 1933 was correctly calculated and justified by the event.

There is much that is hazardous in the figures and the analysis is only submitted tentatively as a basis for discussion. Even, however, if it is only partly right, it emphasizes the proposition that large-scale interference with economic forces is hopeless unless those in control possess adequate statistical information coupled with effective means of remedying maladjustments as and when they occur.

APPENDIX.

SUMMARY OF THE PRESENT LAW (1935) SO FAR AS IT AFFECTS STATISTICAL MATTERS.

Urban Housing is now governed by the Acts of 1925, 1930 and 1935, together with the unrepealed portions of certain other Acts. The following is a summary of existing legislation, so far as it affects statistical matters.

(1) *Provisions with respect to the Repair or Demolition of Insanitary Houses* (Part I of 1925 Act; Part II of 1930 Act).

(a) *Conditions to be Implied on Letting Houses for Habitation*.—In any contract for letting houses at rents not exceeding specified amounts there is implied a condition that the house is and will be kept by the landlord in all respects reasonably fit for habitation (H. A., 1925, s. 1).

(b) *Power of making By-laws*.—Local authorities may, and if required by the Minister must, make and enforce by-laws with respect to houses intended and used for occupation by the working classes, covering a number of specified matters such as drainage, closet accommodation, water supply, food storage, periodical cleansing and redecoration, lighting, prevention of nuisances from underground rooms, etc. (H. A., 1925, s. 6, as amended by H. A., 1935, s. 68). Model

by-laws are issued by the Ministry and a new series incorporating the amendments involved by the 1935 Act has been published.

(c) *Power to make Advances, etc.*—A local authority may advance money to persons or bodies of persons for the purposes of constructing or altering houses or executing repairs; guarantee advances by Building Societies; and remit rates in respect of conversion of houses into self-contained flats (H. A., 1925, s. 92, as amended by H. A., 1930, s. 47). There are limitations upon the sizes of the houses, and the estimated value of the fee simple in possession free from incumbrances must not exceed £800 (H. A., 1925, s. 92, as amended by H. A., 1935, s. 76). If the guarantee extends only to the amount by which the sum advanced by the Society exceeds the sum which would normally be advanced by it without any such guarantee, and the local authority's liability is not greater than two-thirds of the principal and interest, the Minister may re-imburse to the local authority not more than half of any loss sustained by them under the terms of the guarantee (H. A., 1933, s. 2).

(d) *Periodical Inspections—Fitness for Human Habitation.*—It is the duty of every local authority to cause an inspection of their district to be made from time to time with a view to ascertaining whether any dwelling-house therein is unfit for human habitation (H. A., 1925, s. 8). This is additional to duties of inspection under the Public Health Acts. In determining whether a house is fit for human habitation regard must be had to the extent, if any, to which by reason of disrepair or sanitary defects the house falls short of the provisions of any by-laws in operation in the district, or of any local enactment dealing with the construction and drainage of new buildings and the laying out and construction of new streets, or of the general standard of housing accommodation for the working classes in the district (H. A., 1930, s. 63, as amended by H. A., 1935, 6th Sch.). The expression "sanitary defects" includes lack of air space or of ventilation, darkness, dampness, absence of adequate and readily accessible water supply or sanitary accommodation or of other conveniences and inadequate laying or drainage of courts, yards or passages (H. A., 1930, s. 63). The question whether a dwelling-house is unfit for human habitation or not is a question of fact to be determined by the local authority in a judicial spirit. The standard to be applied is that of any ordinary reasonable man, and it does not follow that the whole building is unfit for human habitation because certain rooms are unfit.* Apart from the *Manual of Unfit Houses and Unhealthy Areas* (1919) (now out of print), no specific instructions have been issued by the Ministry, but sanitary inspectors are building up a code of practice the force of which is bound in time to become considerable. Meanwhile local authorities enjoy considerable latitude in the interpretation of these provisions, and the preservation of the phrase "general standard of housing accommodation for the working classes in the district" tends to stereotype existing conditions.

(e) *Power to Require Repair or Demolition of Unfit Houses.*—A local authority may require the repair of any working-class house

* *Hall v. Manchester Corporation* (1915), 79 J.P. 385.

unfit for human habitation and which may be made fit at reasonable cost (H. A., 1930, s. 17), or on default execute the necessary works themselves and recover from the owner (s. 18). If it is not capable of repair at reasonable cost they may, subject to certain reservations, order its demolition and on default demolish it themselves (s. 19).

(2) *Clearance or Re-development of Unhealthy Areas (Part II of 1925 Act; Part I of 1930 Act).*

(f) *Clearance Areas.*—Where a local authority is satisfied that the dwelling-houses in an area are by reason of disrepair or sanitary defects unfit for human habitation or are by reason of their bad arrangement or the narrowness or bad arrangement of the streets, dangerous or injurious to the health of the inhabitants and that the other buildings, if any, in the area are for a like reason dangerous or injurious to health; and that the most satisfactory method of dealing with the conditions in that area is the demolition of all buildings therein, they must declare the area in question a clearance area (H. A., 1930, s. 1). When necessary formalities have been complied with and the clearance order has been confirmed by the Minister, the owners of the property concerned must demolish it or on default the authority may do the work themselves (s. 2). The authority must secure the provision of necessary re-housing accommodation for persons of the working classes in advance and their resources must be sufficient (s. 1).^{*} These are the provisions under which the present slum-clearance campaign is being conducted.

(g) *Re-development Areas.*—If an urban local authority are satisfied that their district comprises any area containing 50 or more working-class houses, of which at least one-third are overcrowded, or unfit for human habitation and not capable at reasonable expense of being made fit or so arranged as to be congested; that the industrial and social conditions of their district are such that the area should be used to a substantial extent for housing the working classes and that it is expedient that the area should be re-developed as a whole, they must declare the area in question to be a re-development area (H. A., 1935, s. 13). Upon confirmation, treatment of the area takes place in accordance with a re-development plan (s. 15). This procedure supersedes the improvement area procedure laid down by the Act of 1930, which was of a permissive nature and of which little advantage was taken.

(3) *Provision for New Housing Accommodation for the Working Classes.*

(Part III of 1925 Act; Part III of 1930 Act.)

(h) *General Authority to Provide Working-class Houses.*—A local authority may provide housing accommodation for the working classes by the erection of dwelling-houses on land acquired or appropriated by them; by the conversion of any buildings into dwelling-

^{*} This is a highly condensed version of the procedure. A number of important matters and amendments introduced by the Act of 1935 have been omitted as irrelevant to the present paper.

houses for the working classes; by acquiring houses suitable for the purpose; by reconditioning, i.e. altering, enlarging, repairing or improving any houses or buildings which have or an estate or interest in which has been acquired by them (H. A., 1925, s. 57, as amended by H. A., 1935, s. 20).

(i) *Review of Housing Conditions and Framing of Proposals.*—It is the duty of every local authority to consider the housing conditions in their area and the needs of the area with respect to the provision of further housing accommodation for the working classes and to submit to the Minister proposals for the provision of new houses (H. A., 1930, s. 25).

(k) *Arrangement with Housing Associations.*—A local authority may promote the formation or extension of or assist a housing association (H. A., 1925, s. 70), and make arrangements with such association for the performance of its duties under the Housing Acts (H. A., 1935, s. 27).

(4) *Miscellaneous Provisions.*

(l) *Periodical Inspections—Overcrowding.*—Local authorities must cause inspections of their districts to be made with a view to ascertaining what dwelling-houses are overcrowded, prepare and submit to the Minister reports showing the results of the inspections and the number of new houses required to abate overcrowding and prepare and submit proposals for the provision thereof (H. A., 1935, s. 1). "Dwelling-house" here means any premises used as a separate dwelling by members of the working classes or of a type suitable for such use (s. 12). For the definition of "overcrowding" laid down by the Act, see Section (11) below. These provisions represent the first attempt by Parliament to secure the abatement of overcrowding on a comprehensive scale.

(m) *Housing Management Commissions.*—A local authority may prepare and submit to the Minister a scheme for the establishment of a Housing Commission with a view to the transfer of all or any of their functions under the Acts with respect to management, regulation and control and repair and maintenance of working-class houses (H. A., 1935, s. 25).

(n) *Central Housing Advisory Committee.*—It is proposed to set up a Central Housing Advisory Committee for the purpose of advising the Minister on certain matters laid down in the Acts. This Committee may also consider the operation of the enactments relating to housing and make to the Minister such representations with respect to matters of general concern as they think desirable (H. A., 1935, s. 24).

(5) *Financial Provisions.*

(o) *Exchequer Contributions.*—Exchequer contributions are available for purposes specified in the Acts, subject to corresponding contributions from the rates (H. A., 1930, s. 26; H. A., 1935, ss. 31, 32 and 33). For details see Section 6 below.

(p) *Consolidation of Housing Accounts.*—Provision is made for the pooling of grants and the consolidation of housing accounts (H. A., 1935, ss. 40-50).

(6) *General Effect of Legislation.*

The outcome of these measures is to make local authorities generally responsible for housing conditions in their areas from the standpoints of quality and quantity. In particular they must arrange for clearance of slums, re-development of congested areas, abatement of overcrowding and repair or demolition of insanitary houses; they must satisfy themselves that sufficient new accommodation at reasonable rents is being provided for the working classes or on failure of outside agencies provide it themselves; they must make and enforce by-laws with a view to the raising and maintenance of housing standards; they may make loans and give guarantees in respect of work done by other agencies. Exchequer contributions are available in respect of re-housing operations for certain specified purposes, and provision is made for authorities to borrow money at the lowest market rates.

The Government is, with the co-operation of the authorities, carrying out programmes calculated to remedy all grosser housing evils by 1941.

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DISCUSSION ON MR. CONNOR'S PAPER.

DR. W. H. COATES : It gives me very great pleasure to propose the vote of thanks to Mr. Connor, who is not only a learned statistician and a hard-working member of the Council of this Society, but also, in his daily life, one of my business colleagues. Like those of other members of this Society, my few observations are spoken in my personal capacity and as such are in no sense the views of my Company.

Urban housing, the subject of this paper, is of particular concern to the Royal Statistical Society because that Society does not limit itself to the abstruse mechanism of the higher statistics, but holds within its sweep all branches of scientific and social interests, provided that they may be susceptible of statistical measurement.

Housing, therefore, matters to us :

- (a) In its social aspect, because the house is the centre of the home;
- (b) In its industrial aspect, for its provision is in that respect of large economic importance;
- (c) From the point of view of health, for proper housing lies at the root of national well-being in that direction ;
- (d) In respect of external appearances working through the beauty of architecture;
- (e) So far as it touches transport through the distribution of population; and
- (f) Because housing has formed, and still forms, the subject of a large State experiment through the instrument of rent control.

Reflecting on the scope of these questions, one might well have thought that in a well-regulated community there would have been few subjects in respect of which statistical information was so plentiful.

But is that so? Unfortunately we have to confess that almost the opposite is the case. Indeed, housing statistics are an excellent example of the British propensity for dealing with important national problems not in the light of, but in the absence of, essential statistical knowledge.

No blame for this state of affairs is to be laid upon the Royal Statistical Society, for it will be remembered that some fifteen or sixteen years ago housing statistics were one branch of knowledge for which a Committee of this Society urged that additional and better information was requisite. Perhaps in part it is the fault of my old colleagues of the Civil Service, but only in part, and we may lay the main blame for this state of affairs upon those who in their wisdom rule us mainly without the necessary instruments of statistical fact and analysis.

Mr. Connor has therefore had to try and make bricks with extremely little straw. He is able to give us in Table I, p. 8, statistics

of the number of houses, totalling some 2½ million, with a subdivision as to the provider, that is, distinguishing between local authorities and private enterprise, and subdividing under each head the number provided with and without State assistance. He is clearly conscious of the limitations of this table, for he says at the bottom of p. 10, that control of the position in regard to slum clearance and de-crowding has been hampered from first to last by lack of adequate statistical information. If I recollect rightly, the Moyne Committee, which reported in July 1933, had in part to base its arguments upon statistics provided by my old Department, the Inland Revenue, dating back as far as 1914—nineteen years before. To our younger members here that must seem like digging into the Dark Ages.

Table II breaks these figures up to some extent by reference to grades of rateable value. Of the 2½ million houses provided between 1919 and 1935 in England and Wales, some 90 per cent. are of rateable value of less than £26 (or £35 in Greater London).

I do not care for a frequency table which includes 80 per cent. of the total in one class, and as this particular class covers the housing of the poor, it is particularly regrettable that we have not the necessary subdivision to enable judgment to be passed on the relations between supply and demand of housing for the poorer classes. Again, some quarter of this 2½ million houses are in the rural districts, and there the necessity for a closer classification is even greater, for it is well known that urban houses command higher rents than rural houses. In rural districts the figures show that about 90 per cent. are in the £26 class.

Table III rests upon the valuable statistics in regard to housing produced by the Registrar-General, who in passing may be congratulated on that section of the Census Report which dealt courageously with this thorny question. But here we are condemned to the ten-year interval of the census. The forecast made in regard to the decade from 1931 to 1941 of a supply-demand index of 105 is encouraging, but not for six or seven years yet shall we be able to judge of its validity. One must bear in mind the trend of population movement in this country, and from that point of view as it affects housing supply, can there be any doubt of the desirability of a census in 1936, notwithstanding the fact that the pressure for such a step has proved fruitless? As a member of the Council for Research on Housing Construction I must confess we said to the Registrar-General that he might apply a little more modern method in his statistics, and when that Report came out at a later date we found to our gratification that he had already done so.

I do not attach much importance to Table IV, which sets out the aggregate expenditure and income of local authorities on housing and the outstanding loan debts for the year ending 31st March, 1933. This information is no doubt of great value as regards local government finance, but its partiality from the housing point of view seems to me to destroy much of its value.

As a taxpayer and a ratepayer, I am, of course, appalled at the thought that the gross outstanding loan debt at the 31st March, 1933, was approximately £500 million sterling, but that water

has passed under the bridge and no good purpose now is to be served by lamenting its total. We might, however, with advantage be given additional information as to the manner in which the liquidation of this burden will be spread over the country. How far is it to be met by progressive or regressive taxation?

As the greater part of the burden of housing falls on Exchequer grants and the small balance not covered by specific income is further reduced by the operation of the block grants under the Local Government Act, 1929, it may be said that for practical purposes the excess cost of housing is borne by the Exchequer. This being the case, it may be surmised that about 50 per cent. is borne by direct and mainly progressive taxation and about 50 per cent. by indirect and mainly regressive taxation.

I have referred to the fact that housing has been made the subject of a great State experiment in control. Those of us concerned with industry are not unmindful of the tendency in some quarters towards greater measures of planning under State auspices. Students of this matter might with advantage consider Table X of Mr. Connor's paper, which sets out particulars of the various methods adopted for granting subsidies in respect of housing for the seventeen years from 1919 to 1935.

I have no comments to make on this table except to suggest that the variety of State methods of dealing with one problem provides much food for thought. Any subsidy must upset the balance of economic forces. But rapidly changing methods of subsidy just play havoc with industrial interests and with orderly progress of all kinds. The analysis of normalized costs of working-class houses from 1921 to 1934 as given in Fig. 2 on p. 43, throws up the movement of economic forces over a period, and gives much point to Mr. Connor's contention that large-scale interference with economic forces is hopeless unless those in control possess adequate statistical information coupled with effective means of remedying maladjustments as and when they occur.

Much of this vast burden of debt has been raised by loans running over a long period at fixed rates of interest, which are not unlikely in a changing world to prove out of harmony with prevailing general economic conditions. We have not, in fact, yet realized the inconsistency of fixing rates of interest for long periods in a fluid world. We are still blind to the conflict so set up between debtor and creditor, for, unlike the engineer who deals with such a reality as steel, finance omits to provide for the effects of expansion and contraction.

Indeed the whole burden of Mr. Connor's paper is how little we know from a statistical point of view of the housing problem. If it serves to stimulate those who rule us with a desire to do better in the future and for that purpose to arm themselves with the necessary knowledge, notwithstanding the difficulties that may stand in the way, Mr. Connor may be able to congratulate himself on having added not only to the wealth of material available to this Society, but also to every one concerned with a social problem which goes to the root of well-being. Mr. Connor has rendered a much-needed

service to the Society, and it is for that reason that it gives me so much pleasure to propose this vote of thanks to him.

MR. S. P. VIVIAN : I rise with the greatest of pleasure to second the vote of thanks to Mr. Connor for his paper, which is a very considerable piece of work, involving a tremendous amount of labour. It provides for all students large masses of facts as regards the historical development of legislation on this important subject and the financial aspects of housing in general. I think that everybody who has to deal with this subject, particularly from those aspects, must be particularly thankful to Mr. Connor for having put the facts on record.

Passing to comment on the paper, I do not find myself assuming with the same facility as the proposer the extreme paucity of statistics relating to housing. In regard to rent and the financial and economic aspect of housings, it may be the case that the available statistics are inadequate; but from the extensive tables and mass of valuable matter which Mr. Connor has produced on these aspects, I cannot, although ignorant of them myself, conclude that he has found the cupboard entirely bare.

I do not wish to follow Dr. Coates in criticism of existing legislation or of the Government policy: the backs of the Departments themselves are broad enough. I want to confine most of my remarks to one or two points of statistical interest about which it seems to me there is something to be said.

In the first place, on p. 14 in the footnote Mr. Connor says :

“ According to the Registrar-General, the shortage of housing accommodation in 1931 was represented by 1·7 million new houses needed by 1941 before reaching saturation point.”

That, I feel sure, he will wish to phrase differently. The number of houses estimated to be needed between 1931 and 1941 hardly represents a shortage of housing accommodation at 1931, since it primarily includes the number of houses rendered requisite by the growth of population and families after 1931. It also takes into account the number of houses estimated to be necessary for carrying out the Government's declared intentions as to the removing of certain defects; but that 1·7 million houses represented the estimated shortage of housing accommodation in 1931 is a suggestion which, I am sure, his footnote was not intended to convey; and I believe that on looking at it again he will see it to be misleading.

And there is a small point with regard to his statement of the absence of statistics, on p. 23 :

“ There are sundry omissions of which the following may be noted :

(a) Statistics of demolitions, conversions and adaptations.”

It may be the case that there are no figures expressly stating the numbers coming under these heads; but they are taken into account

in the Census handling of this subject, as will be seen in the Census Housing Report.

On p. 23 it is stated that :

“ No authoritative statistics of overcrowding exist at present, but the omission will be made good under the Act of 1935.”

This is correct if it refers to statistics of overcrowding in the sense of records of particular houses overcrowded. These facts are not, and cannot be, available until action is taken by local authorities under the recent Act. But as regards *statistics* of overcrowding the position is now very different from that obtaining when the subject was discussed in this room on the occasion of Mr. Caradog Jones's paper on the Merseyside Survey. It was then discussed in relation to statistics based on pure density standards, and of these standards or ratios no one could say with any certainty whether they had any relation to the actual facts of practical overcrowding conditions. Since then, however, it has been established that certain density ratios have a very precise equivalence with particular formulæ of overcrowding based upon the usual causes of age and sex separation. The customary Census level of “ over two persons per room ” has been shown to coincide very exactly with a particular formula constructed on the same principles as the present statutory formula. The level of “ two persons per room and over ” has been shown to coincide very closely with the similar formula adopted in the London Life and Labour Survey. Thus density ratios have been shown to provide a statistical expression of overcrowding in its ordinary practical meaning; and the great mass of Census density statistics which are available cannot now be disregarded as irrelevant to the practical conception of overcrowding, but provide real evidence of the existence and distribution of overcrowding according to a formula standard which, though differing from the statutory standard, is very similarly constructed. Thus it is hardly true to say that no overcrowding statistics exist at the present time.

I should now like to come back to certain aspects of the general question of the absence of housing statistics and the particular means by which it is sought to remedy that deficiency by the Council for Research on Housing Construction quoted in Mr. Connor's paper. I am not suggesting that he has made himself responsible in his paper for these proposals; but as they have been made it may be of interest to the Society to examine them. The particular idea is that the housing survey which has to be carried out for the purpose of the execution of the new Act will in some way serve as a means of rapidly obtaining general housing statistical information. I think it will be found that if any attempt were made to use these records for the purpose of providing comprehensive housing statistics of any kind, certain features, extraneous to their immediate objects, would have to be grafted upon them.

It is stated that the Census is of no use as a Housing Survey, and this is true in the sense that it does not tell you, for example, which houses ought to be pulled down. It seems to me that there

is some little confusion here between the provision of statistics and the records needed for the exercise of executive powers. Quite clearly the local authorities will have to have information as to which houses come within the scope of their duties, in order that they may deal with them. Clearly also such records will need to be kept up to date. But let us see what more will be needed before such records can be utilized as material for general housing statistics.

In the first place, they will have to be kept in accordance with classifications uniform all over the country. All of us here who have dealt with statistics involving classifications know that the simplest classification develops under working conditions all kinds of borderline cases and ambiguities which involve interpretation; and uniform interpretation is necessary in order to work them and to secure that they are uniformly applied. In the case of the Census, that is secured because the classifications are applied by one authority; but in this case the records will be worked by a large number of local authorities: and to secure a uniform classification it will be necessary for the central authority to impose a most rigid control, and to enforce upon them all a rigid adherence to established rules of interpretations. The prospect is not a very promising one.

The next thing is that if the figures are used for national purposes, or for comparisons between one area and another, they will have to represent the same point of time. Now the local authorities will doubtless keep their housing register up to date, but they will do so by different procedures and by revision at different times. Thus a datum line date for all authorities will mean in effect a simultaneous re-survey by inspection. I suggest that a picture of the inspecting staffs of local authorities carrying out re-surveys simultaneously all over the country does not differ very greatly from a picture of the machinery of Census enumeration.

These are two aspects in which Census principles would have to be grafted upon the local housing register system in order to enable them (not very effectively, I think) to take the place of the Census in the provision of housing statistics. When the Council, to go a little beyond the quotation of its proposals included in this paper, proceeds to suggest that the provision of statistics in this way would dispense with the considerable delay which is unavoidable in converting the material into statistics through the Census processes of tabulation, I think it is pertinent to enquire how it is that the same task could be done with greater celerity by more diffused and less experienced agencies. Thus it seems to me that the suggestion referred to at the bottom of p. 21—though Mr. Connor is not to be saddled with it personally—is one that deserves discussion, and that we should recognize quite definitely the inherent difference between the keeping of records for use in the performance of specific executive duties and the wholly different function of providing material which is capable of conversion into statistics.

I apologize for these lengthy observations, but as this is a Statistical Society and this paper relates primarily to housing statistics, I thought it not untimely to examine this proposal. We are apt to regard the Census system in the light of an historical accident which

has grown up with us and has to be put up with, but might have been bettered. The truth is that as a system, however indifferently administered, its principles are permanent and inevitable,—and if the object is to provide statistics about people, they force their way back into any alternative machinery which it may be attempted to construct.

I am sure that I have exceeded my time ; and it only remains for me to repeat my appreciation of the paper and my sense of the service which it will render to students of this important subject.

MR. L. J. GOLLOP said that it gave him great pleasure to associate himself with this vote of thanks to Mr. Connor, and in view of what had been said he should perhaps make it clear that he was speaking in a personal capacity and not in any way on behalf of the building industry or the Building Industries National Council. His association with that Council did tend to make him regard the paper from the point of view of the building industry, and one of the most striking statements was to be found at the bottom of p. 10, that " Opportunities of coming to a definite arrangement with the building industry were not exploited as they deserved." That was a considerable under-statement. Except during the War period, the building industry was only once consulted on housing, in 1924, when a National House Building Committee was set up to advise the Government of the day on its housing programme. Unfortunately the Government of the day was not long in office. Then again later, after the Government had instituted in 1931 the economy campaign—which spread, and by 1932 brought with it extensive unemployment in the building and related industries—when those industries approached the Government of the day they were informed that the building industry was not speaking with one voice, and therefore official cognizance could not be taken of what was said. Immediate steps were taken to set up a Council which would enable the building industry to speak with one voice, and the Building Industries National Council was formed. This Council, which was a new body, brought together organizations interested in the building and allied industries. Organizations, in order to belong to the Council, must be national in scope, and bodies adherent included :

The British Electrical and Allied Manufacturers' Association.

The British Tube Association.

The Building Material Manufacturers' and Suppliers' Committee.

The Chartered Surveyors' Institution.

The Federation of Civil Engineering Contractors.

The National Federation of Building Trades Employers.

The National Federation of Building Trades Operatives.

The Plate and Sheet-glass Manufacturers' Association.

The National Gas Council.

The Reinforced Concrete Association.

The Royal Institute of British Architects.

It therefore represented the entire industry, so that now it was possible for the authorities responsible for housing to consult through

properly organized channels the industry responsible for the carrying out of that housing policy. The Ministry of Health Advisory Committee, the constitution of which was announced that morning, did not do that: its functions were limited; it could only state its views on specific matters referred to it by the Minister.

If the industry is to be able to commit itself to what it would or would not do, adequate information must be made available on which judgments could be based, and since the chief purpose of Mr. Connor's paper was to point out the need for further information with regard to housing, then the building industry was with him whole-heartedly. In this respect the building industry realised that it had a double responsibility; in the first place it must press for additional information from the powers that be, but in the second place it must disseminate that information among the members of the industry. It was not enough to set up an "industrial civil service" if the information which become available was not passed on. That was one of the chief purposes of *The Building Industries Survey*, the monthly economic and statistical publication of the Council referred to in the paper.

There were two other aspects which were important from the point of view of the building industry:—

1. That the position of the building industry with regard to any housing programme, or with regard to the progress under any housing programme at any particular point of time, could only be judged if its other activities were taken into account, and that must be the basis of any housing policy in any country. That was shown clearly by the index of capacity given in Table XIII on p. 42—the number of insured persons. The figures of 1934 and 1935 should go on to the end of the table to bring it up to date, and these were 136 and 143, from which it was clear that the capacity had increased since 1933 by 43 per cent. but the output of houses had trebled. It was clear that the capacity related to the total capacity of the building industry and could not be related to a specific factor such as housing.

Housing policy must be flexible and take account of these other factors and be regulated according to them. It was, as was pointed out in the paper, impossible to expect a large increase in the supply of houses if at the same time the building industry were busily engaged on other work, without increased costs either directly through rises in prices or indirectly through wastes and delays.

With regard to Mr. Connor's point as to the possibility of an early slump in the building industry, Sir George Schuster had gone so far as to give the date of this movement as 1937 or 1938. In view of the fact that the increase in building activity had undoubtedly been a major cause of increased economic activity since the last slump, that was a very serious prospect for the country as a whole, and the question was what would take its place. As had been already pointed out, the problem of slum houses was being tackled, but it must be borne in mind that one-third of the workers' lives was spent in factories and workshops and offices, and it seemed to him that the problem of the slum factory, workshop and office ought to be brought into consideration; from the social point of view they

were almost as important as housing, and from the economic point of view of course they had a direct effect upon efficiency. These questions of slums, however defined, and the 1935 Housing Act, raised the general problem of obsolescence, and it would seem that the chief objective of housing policy would be to tackle this general problem. The Registrar-General's estimate of housing needs was that saturation point would be reached if 1,700,000 houses were built by 1941, and this included an estimate for replacement given as one hundred thousand houses for ten years, or ten thousand a year. A replacement of ten thousand a year of 10 million houses gave a life per house of one thousand years. The comparison was not quite fair in view of the larger number of houses built in recent decades, but even so it was clear that current opinion under-estimated the importance of obsolescence, since the life of a house in efficient repair was one hundred years.

[The following was submitted by Mr. Gollop after the meeting.]

One of the most interesting parts of the paper from the point of view of the building industry is section 17, on the building cost of working-class houses. While in general agreement as to the method employed, I would like to make the following brief observations:—

(1) It is stated that wages, materials and residuals are of approximately equal weight as constituents in costs. Assuming that the work is carried out by contract, the proportions would be (roughly): wages 35 per cent., materials 50 per cent., residuals 15 per cent.

(2) The choice of index-numbers in Table XIII is governed by the need for a long series. The index of wholesale prices of industrial materials employed, however, is heavily weighted with imported raw materials which have fallen considerably in price. A more appropriate index would be the Board of Trade index of manufactured industrial materials, which is available from 1930. The substitution of this index has a considerable influence on the figures in the table.

(3) Immediately following figure 2 it is stated that "the function of a subsidy is to stimulate demand." But the function of a subsidy is surely to stimulate supply. The housing subsidy is paid to the local authorities, which are thereby enabled to increase the supply of houses and to let them at uneconomic rents. Since the subsidy defrays part of the cost, the effect is to lower the supply curve and to move it to the right. The effect on prices (*i.e.* rents) depends on the shape of the demand curve near the point of intersection. Since demand at this point is elastic, the importance of the shape of the supply curve is, that if it is falling rents will be reduced by more than the subsidy, while if it is rising the reduction will be less than the subsidy.

During the discussion, reference was made to my deductions from the Registrar-General's estimate of normal obsolescence replacement during the period 1931-41. I should like to say that I was not

criticizing the Registrar-General, but was merely using his estimate as an illustration of current views on obsolescence. My point, however, does not depend on the reference to that estimate. During the decade 1921-31 the number of houses built exceeded the increase in the number of houses recorded in the Census by about 200,000. Taking this as a rough measure of obsolescence replacement during that period, an average of 20,000 houses were built each year to replace obsolescence in some 8,000,000 houses existing in 1921, the average life of the houses being about 400 years. It is true that this is not accurate, since more houses have been built during recent than during former decades, but greater accuracy cannot be attained because the average age of existing houses is not known. It is, however, clear that obsolescence replacement has been too small in relation to a maximum useful life for a house of 100 years, and there would appear to be little doubt that if obsolescence replacement had been more rapid in the past, and the powers of local authorities to declare houses unfit for human habitation more vigorously used, the slum problem would not have attained its present dimensions.

MR. V. P. A. DERRICK said that he desired to call attention to what he thought was a fallacy in the last part of the previous speaker's remarks so far as he understood them, viz. a suggestion that the allowance of 10,000 replacement dwellings per annum in the Registrar-General's housing forecast was absurd in that it implied in relation to an existing total of ten million dwellings, that the average lifetime of a house was 1,000 years. He desired to point out, first, that the figure of 100,000 for the decennium 1931-41 was only one item in a total replacement allowance which comprised in addition 300,000 renewals in respect of slum demolitions, and a further considerable unspecified addition as well, and secondly, that, in considering its adequacy, comparison should be made not with the present total of dwellings, but with the number existing when the condemned properties were built, which was only a fraction of the present-day figure.

DR. BUTLER said he felt sure that there was one sentence—the last read by Mr. Connor—with which everyone would heartily agree: “This large-scale interference with economic forces is hopeless unless those in control possess adequate statistical information coupled with effective means of remedying maladjustments as and when they occur.” Nothing could more clearly exhibit the truth of this than the fact that the present housing problem was very largely, if not entirely, the outcome of such an interference.

Prior to Mr. Lloyd George's Budget in which the taxation of ground values was imposed and the effect of which, incidentally, was to drive the speculative builder—the instrument, hitherto, of the provision of new houses—out of business, the housing problem solved itself on what might be called natural lines. But this Budget and, later, the Rent Restrictions Act were a large-scale interference with economic forces, some of the main results of which had neither been measured nor even considered; working-class houses, in the

circumstances created by these measures, could no longer be economically provided and the initiative on which hitherto this provision had, not unjustifiably, relied was killed. As a direct consequence of the Rent Restrictions Act, those already in occupation of houses refused to remove from their privileged positions to unsheltered houses no longer protected, however roughly, by the free play of economic forces: they got "dug in," so that nothing could displace them.

So disproportionate were the rentals of controlled to those of new and uncontrolled houses, even when these latter were assisted by subsidies amounting to as much as £1 a week per letting, for a period of 60 years. that it was found impossible to transfer the people displaced by slum clearance to the subsidized houses provided for their accommodation, and those displaced persons were in effect driven on the top of people immobilized under the Rent Restriction Act, enriching the protected tenants financially, but resulting in gross overcrowding in the rent subsidized houses. Here were evils, the direct outcome of large-scale interference with economic forces without adequate knowledge. On the one hand, the economic provision of new houses had become impossible and had ceased, and on the other, subsidized provision by the local authorities failed to meet the needs and means of those for whom they were provided. He could remember, prior to the speculative builders going out of business, that there was commonly 4 per cent. or 5 per cent. of empties which permitted a mobility of working-class population no longer possible. There was, as a result of new houses economically provided, a general uplift which came through a supply of houses somewhat in excess of demand, proportionally rented and enabling those who could afford to move out of the less satisfactory into better houses and others to move into the houses thus vacated. While they would all be agreed with Mr. Connor's proposition that interference in the absence of adequate knowledge was hopeless, it by no means followed that large-scale interference with economic forces, even when Mr. Connor's conditions were satisfied, offered prospects that would command their approval. But that was another question.

DR. ISSERLIS said as there seemed to be a certain shyness amongst speakers who were not directly connected with the provision of houses, he might perhaps be allowed to say a few words. He would like to register a mild protest against a part of the contents of the paper—not in any unkind way. The founders of the Society were at first rather rigid; they thought that papers presented to the Society should deal purely with statistical matters in tabular form, and while they had departed from that a good deal, and had had papers dealing with the more recondite parts of bank finance and economics, as a rule they had had papers in which conclusions were drawn from the tabular matter in the paper. Now the author had quite properly pointed out that suitable tabular matter was lacking, and it was a very suitable thing for the Society to point in an important direction and say, "Statistics are lacking and ought to be provided." He had a kind of feeling, however, that there was a good deal of dis-

cussion and drawing of conclusions in the paper based on matters outside the inadequate tables, and therefore he thought the previous speaker, seeing the nature of the paper and the nature of the discussion, was perfectly correct in making his very important contribution to the discussion as it stood. Otherwise perhaps he would have been ruled by the Chairman to be out of order, if the paper had been purely statistical. If he might commit a similar error, he would like to ask why in the portions of the paper read there had been practically no reference to the fall in the rate of interest in the last two and a half years. Looking at the major table in the paper, more than one quarter of the houses built in thirty half-yearly periods were built in the last five half-yearly periods, viz. in the period of cheap money. If the author were merely dealing with deductions from statistical matter, Dr. Isserlis would have thought that that point would have deserved a somewhat lengthier treatment than it had received in the paper.

MR. STEWART SWIFT said that as a visitor to the meeting from the Public Health Service, he would like to express to Mr. Connor his keen appreciation of the paper, which had put many thoughts into his mind which he was afraid those who dealt in the administration of housing laws had not thought of before. The Public Health Service would be with Mr. Connor all the way in his desire for better statistical information, but they wanted to ask Mr. Connor and the Society, and anyone who could help, just how the statistical information required could be obtained. The first difficulty in gathering together accurate and reliable information was the question of definitions. They were faced at the moment in the Housing Act of 1935 with a very big problem as to what was and what was not a working-class house, and different districts were finding great difficulty in deciding which houses must be included in that category.

Mr. Connor had also referred to questions of standards of fitness in old houses, and he was kind enough to refer in his paper to an attempt made in Oxford to deal with the question of standardizing unfitness in working-class houses. The full extent of the problem might not be known to all the audience, but the officers of local authorities were faced with great difficulties in classifying unfit houses. It was not so difficult to decide on matters of sanitary accommodation and water supply; but when it came to matters of structural disrepair, it was very difficult indeed, and the surveys of unfit houses in 1919, 1930 and 1933 were quite inadequate. He did not think it was quite fair to suggest that blame should be attached to the Ministry of Health or the local authorities, who had the job of compiling the figures. The difficulty of gathering information which was reliable in accordance with rules that could be made applicable to the country as a whole was very considerable.

The immediate problem of overcrowding was concerning local authorities at the moment, and, so far as the collection of reliable statistics was concerned, presented two problems: (1) what was a working-class house? (2) What was a room? These were perfectly

simple questions that ought to be capable of easy answer, but in the Act there was very little guidance, and some authorities would classify a room as a "room" within the meaning of the Act, whereas an exactly comparable room in another town would not be classified as a "room" at all for the purpose of overcrowding information.

It was very important to realize that in previous surveys, local authorities had been very much restricted as to time; it must be remembered that the officers who have to collect statistical information regarding housing are not concerned with housing alone, but have other duties to perform, and in the past the Ministry of Health had restricted the time within which the information must be collected, with the result that the information had been incomplete and inaccurate. This was one of the difficulties.

Mr. Stewart Swift expressed his great appreciation of the paper, and whilst he was quite incapable of contributing anything of value from the purely statistical side, he wanted members of the Society to realize that those who had to collect these statistics had to labour under great difficulties, and would be very grateful for anything that could be done to help them.

DR. C. O. GEORGE said the remarks of one of the previous speakers regarding the need for figures in papers read to the Society reminded him of a classic paper read by a high authority a year or two ago in which, he believed, the only figures were those at the top of the galleys. No one could criticize Mr. Connor in this direction, for the paper was one of the fullest he could remember, and one could, in fact, only feel amazed at its comprehensiveness, ranging as it did from the hundreds of millions spent on housing down to the place where flat-dwellers stored their kitchen and other utensils.

At such a late hour he would refer only to one point, namely, the "supply-demand index" appearing on p. 12. It was with much hesitation that he would criticize, or even question, any statistical conception of so eminent a statistician as Mr. Connor. Yet he must confess to feeling some little doubt when he saw this "supply-demand index," based as it was on the figures for 1911, a year when "supply" did not equal "demand," although in the calculation of the index, "supply" and "demand" were both reckoned as equal to 100. In particular, he felt some qualms when the index was used for comparison between subsequent decades, and he would be glad if Mr. Connor could give some reassurance as to its statistical impeccability, and at the same time, perhaps, explain why the basis adopted was chosen in preference to a simpler index, such as, for example, the actual "total of structurally separate dwellings" shown as a percentage of the "total of private families, two persons or more."

PROFESSOR M. GREENWOOD said that as time was getting on he would not call on any other speaker, but would give Mr. Connor the traditional warning that he need not reply at length to the speakers at present, but could reserve his reply for the *Journal*.

Professor Greenwood was afraid he could not contribute anything to this lively discussion, because the subject was mysterious to him. One part of the Society's work was concerned with higher mathematics, which were above him. Another part, illustrated by the masses of tables in this paper, was not below him, but sometimes impenetrable. He thought he had found something in the paper that he could understand when he saw a simple equation, as he felt his mathematical grasp included simple equations—but even there was something mysterious. On p. 40, C was said to be the cost of building, comprising three items of approximately equal weight—wages, materials and residuals—and he would have thought on those definitions that C could be equal to $R + W + M$. But as far as he could make out from the equation, the total cost of the operation was only one-third of the total costs, which seemed to him to be transcendental mathematics. Possibly there was some special definition of C that he had missed. He was quite sure that anyone who studied these tables carefully would be much wiser than when he began, and he thought every Fellow of the Society ought to feel that that last sentence in the paper, to which Colonel Butler had already referred, was an enthusiastic valuation of the service which was rendered to the world by this Society which stood for statistics. He doubted, however, whether additional statistical information would really have sufficed to prevent the Great War.

The proposition was that a hearty vote of thanks by the Society be given to Mr. Connor for his paper.

MR. CONNOR thanked the meeting for the reception given to his paper and expressed his satisfaction at having two such eminent statisticians as Dr. Coates and Mr. Vivian for proposer and seconder. He was glad to see Mr. Stewart Swift as a visitor, because he owed a great deal to the latter's text-book on *Housing Administration*. He would submit a written reply to the discussion.

Mr. Connor later wrote as follows:—

I am obliged to Dr. Coates for supporting and developing my lines of argument. His support is the more valuable since he has studied the problem from both sides: first as late member of the Committee on the *Collection and Presentation of Official Statistics*, and, second, as Chairman of the technical panel which drafted the Report we have been discussing.

On the other hand, Mr. Vivian dissents in certain respects. This is probably because he is interested in housing statistics as a measure of social conditions, whereas this paper contemplates them in a form useful to the housing administrator. He has also drawn attention to certain inadequacies of expression, which I am adjusting in the text.

Mr. Gollop's agreement with the proposed index of building cost (Section 17) is encouraging. With regard to his specific suggestions, I am not so much exercised with the particular figures of Table XIII as with the general method, which is believed to be novel in this

field of enquiry. Evidently this is a matter for expert study, and it is hoped that it will be taken up by the *Building Industries National Council*. Mr. Gollop and I differ on the question whether subsidies stimulate "demand" or "supply." I maintain they stimulate "demand" because they emerge in the shape of prospective increases in the purchasing power of local authorities, from which orders for new houses originate.

Most authorities agree in reckoning the useful life of a dwelling-house at 80-100 years, and upon this basis the normal replacement figure should now stand at 50,000 houses per annum, the figure adopted in Table III for purposes of illustration. The point has been cleared up by Mr. Derrick.

Dr. Butler's contribution towards the discussion raises a point which I have taken for granted. It is the economist's duty to study the problem of State interference and point out its consequences, but fortunately not his duty to pass a verdict.

I agree with Dr. Isserlis that some discussion of the effect of interest rates would have been advisable: my excuse is that the paper is already overloaded. I fully appreciate Mr. Stewart Swift's difficulties in the matter of definitions, but believe that a solution will be found on the lines upon which he is now engaged.

I am obliged to Dr. George for pointing out possible grounds for misapprehension in the Supply-Demand Index in Section (4). Both "Supply" and "Demand" as applied to housing are nebulous quantities, and it is important to avoid any form of statement that conveys more than is intended. In this background an index, which is carefully based on 1911 as standard, is less tendentious than the form of statement proposed by Dr. George, which appears to involve a judgment as to the proper ratio between families and houses.

Professor Greenwood draws attention to an ambiguity in Section 17, dealing with building costs. It should be emphasized that the quantities entering into the equations of p. 40 represent index numbers and not actual figures, and upon this basis it is permissible to combine them in the form of averages. The advantage of using averages is that they save mental arithmetic in reading Table XIII and secure complete uniformity in the scales of Fig. 2. I did not elaborate the point in the text, and am glad of an opportunity of doing so now.

In reply to a question from one of my correspondents regarding column 12 of Table I, it should be explained that the Ministry of Health gave access to certain unpublished figures regarding costs of working-class houses provided by public enterprise, from which I have, on my own responsibility, constructed an index of cost. The absence of any base is explained by the fact that the column represents the estimated average cost in pence per square foot of working-class houses of all types, and since an index suggests a lower degree of precision than an actual figure, the results were tabulated in that form. The figures are believed to be sufficiently reliable for the limited objects for which they are used in this paper. I should deprecate their use for any wider purpose.

As a result of the ballot taken during the meeting the candidates named below were unanimously elected Fellows of the Society :—

Mark Alexander Abrams, Ph.D.	Hamilton Albert Hopkins.
Ali Abdul Wahed Aly.	Neville Ubesinghe Jaywardena.
Bernard Babington Smith.	B.Sc.
Leslie E. Bird.	Nowzer Mehta, B.Ag.
Wilfred Israel Eitzman.	A. C. Mukherji.
Muhammad Sabriel Far.	Bernard Frederick Picknett.
Arthur Alan Forty, M.R.C.S.,	Roland Pumphrey.
L.R.C.P.	Douglas George Rose, B.Sc.
Terence Horatio Gates.	Robert Bryan Rowson.
Alexander Thomas Kingdom	Lionel Percy John Atkins Scofield.
Grant.	Pandurang Vasudeo Sukhatme.
Amahendu Guha, M.A.	Ragland Thomas.
Siri Hoontrakul, A.C.A.	Robert Ross Waddell.

Representatives of Corporate Bodies.

H. Basil Sheasby, A.S.A.A., *representing* the Society of Incorporated Accountants and Auditors.
 Harold Edwin Caustin *representing* the Institute of Statistics, University of Oxford.

A STATISTICAL SURVEY OF THE CINEMA INDUSTRY IN GREAT BRITAIN
IN 1934.

By S. ROWSON, M.Sc.

[Read before the ROYAL STATISTICAL SOCIETY, December 17th, 1935,
the PRESIDENT, PROFESSOR M. GREENWOOD, F.R.S., in the Chair.]

IN a long record of communications to this distinguished Society, covering more than a century of the economic, social and political history of the British people, it is significant that there has been no attempt to deal in any way with their recreations, amusements or entertainments. The discovery of this omission was the result of a patient examination of the valuable series of indexes to the Society's Transactions, and the fact surprised me. A momentary feeling of elation passed through my nervous system at one stage of my search when I unearthed, in one of the earliest volumes, a subject with the expressive and resounding title of "Angles and Triangles." Surely this must refer to the alleged staple ingredient of the cinema drama and, as we are so frequently told, of the cinema. But, alas, my disappointment was equal to that felt by the owner of an Irish Sweepstake ticket on the day the drums are revolving. That disappointment was, however, quickly dispelled by the glow which I felt when I realized that my paper to-day is a pioneer effort in the scientific investigation of the social and economic problems of the people's amusements and recreations, and perhaps also in the still wider field of the economics and philosophy of leisure. I hope that some other investigator with more time and patience than myself will take the torch from my hand, and will succeed in illuminating other corners of the enormous field of leisure and give us a comprehensive picture of the part which it occupies in the economic, social and spiritual lives of the people. I can promise him an ample reward for his efforts.

An appropriate beginning to the present survey is the measurement of the hold which the present-day cinemas have upon the population. Some information on this subject was contained in a brief communication which I made at the Aberdeen Meeting (1934) of the British Association, and subsequently reproduced in the *Journal* of this Society (Vol. XCVII, pp. 633-640). Since then I have been supplied with other and later information which permits of a fuller, and possibly more accurate, development of this theme. As now presented the results can be accepted as possessing a reasonable degree of accuracy.

There is, of course, no direct method of ascertaining either the number of admissions or the sums paid by the public to the cinemas in a year. That the figures must be large is obvious to the most casual of observers. There must be very few who have not, at some time, been impressed by the large number of cinemas in the areas in which they move, the number of new buildings in course of erection along the principal thoroughfares of all our large and small townships, the queues of people patiently waiting outside, the space devoted in all our newspapers to the programmes offered in the area in which they circulate, and who have not said to themselves, "There must be millions of people every day who find entertainment, perhaps amusement, certainly relaxation, in this great new institution, entirely unknown to any previous generation." But how many millions? And how much do they pay? These are the first questions to which an answer is attempted.

There are two valuable sources of information which may be drawn upon for an approximate answer to each of these questions. The first is the yield of Entertainment Duty. The second is a return of the number of admission tickets of various denominations sold for use in a large proportion of certified houses. The Entertainment Duty is collected partly by special adhesive stamps on each ticket, and partly by special tickets issued to certain cinemas from authorized firms of ticket-printers. By arrangement with the Excise Department these printers are compelled to issue to each cinema on their books, rolls of tickets of every desired denomination consecutively numbered. The Excise officers are thus able to check the number of each kind of ticket sold since the previous return, and collect the appropriate amount of duty. These ticket-sales can be assumed to be an accurate return of the conditions prevailing in those cinemas to which they are supplied. The returns with which I have been provided relate to over 650 million tickets supplied in 1934, and may be safely regarded as an excellent sample of the conditions in so-called "certified" cinemas.

An authoritative estimate of the yield of the Entertainment Duty in the calendar year 1934 gave the figure as about £6,800,000, of which £5,220,000 came from certified houses and £1,580,000 from stamps and stamped tickets. The 650 million tickets already mentioned were sold as in the following table, in which will be found the proportion of the total number of tickets at each price-denomination and the rate of Entertainment Duty appropriate to each admission price. From this table the following deductions are readily obtained by simple arithmetical calculations. The sum of the products of the figures in the first and third columns is proportional to the total duty collected. Similarly, the sum of the

products of the figures in the second and third columns is proportional to the total gross receipts. The ratio of these two gives the factor by which the yield of the duty must be multiplied to give the

TABLE I.
Analysis of 650 Million Cinema Ticket Sales in 1934.

Rate of Entertainment Duty in pence	Price of Tickets (including Duty) in pence	Percentage of Tickets at each price
—	1	0.36
—	2	1.42
1	3	3.90
	4	4.59
	4½	0.01
1	5	3.89
	6	8.96
	7	17.97
	8	0.41
1½	8½	0.01
	9	15.91
	10	0.06
2	11	0.16
	12	21.01
	13	0.02
	14	0.09
2½	14½	0.05
	15	4.84
	16	2.34
3	17	0.02
	18	7.69
	19	0.00
	20	0.03
4	21	0.04
	22	0.35
	24	2.15
	26	0.00
	28	0.14
5	29	0.07
	30	1.67
	32	0.00
6	36	0.07
7	42	0.68
8	48	0.00
	51	0.00
9	54	0.01
10	60	0.05
12	72	0.07
17	102	0.01

total gross receipts. It will be found that, over the entire scale of prices, this factor is almost exactly 6, and therefore the gross receipts in certified houses were £31,320,000. Another deduction from the

table obtained by dividing the sum of the products of the second and third columns by the sum of the numbers in the third column gives the average price paid for admission in these cases. The result is 10·54*d.* It follows that the number of admissions to certified cinemas in 1934 would have been

$$\frac{6 \times 5.22 \times 2.4 \times 10^8}{10.54} = 713 \text{ millions.}$$

To this number there must be added those who were admitted by stamped tickets. Generally speaking, the houses where this practice prevails are smaller cinemas with a lower average of admission prices, and with a top price not exceeding 1*s.* 3*d.* to 1*s.* 6*d.*, and for these it appears that from the foregoing table the gross receipts amount to 6.20 times the duty collected. This amount was, therefore, £9,800,000 (*i.e.* 6.1 × £1,580,000).

I have been supplied with the figures of ticket sales for cinemas described to me as of this second class for the three months ending September 30 of the present year. These sales, numbering over ten millions for the period in question, were, doubtless, affected by the remission of the Entertainment Duty in the lower-priced seats which came into operation on July 1st last. Except that one direct effect of this remission was an increase in the number of tickets issued at 6*d.* to those who previously paid 7*d.*, it is unlikely that the average price (excluding duty) paid in this group was seriously affected by the change. Making due allowance for the duty in this case, the average for these seats was 9.42*d.* (including duty). Applying this figure to the estimated gross receipts of the non-certified houses outside those covered by the first set of returns, which, as has been said, amounted to £9,800,000, the additional total of admissions in these cinemas in 1934 must have amounted to

$$\frac{9,800,000 \times 240}{9.4} = 250 \text{ millions.}$$

In all the cinemas of Great Britain, therefore, the total admissions in 1934 were about 963 millions, or at the rate of 18,500,000 per week; the total gross box-office receipts were about £41,120,000; and the average price paid per seat was 10.25*d.*

However else it may be regarded, this figure is eloquent of the hold which the cinema has acquired over the population. This total number of paid admissions represents an average of nearly 22 visits every year for each man, woman and child in the country. A more significant figure is obtained by ignoring children under 15, who represent a relatively small fraction only of the total cinema patrons, comprising adolescents and adults almost exclusively. For

persons aged 15 and upwards, the average works out to nearly 30 visits every year. If it were possible to eliminate all that portion of the population to whom a cinema is practically inaccessible, either because of distance or for any other reason, it is clear that the average in relation to potential patrons must be a very much higher figure; how much higher it is impossible at present to determine.

There is undoubtedly much interest and some importance in measuring the number of cinema admissions at each of the principal price-rates. This is, of course, easily obtainable by combining the two sets of figures, the first of which is shown in Table I and the second which is not here reproduced. The results of this combination are set out in the following table.

TABLE II.
Estimated Distribution of Cinema Admissions in 1934.

Rates of Admission (including Duty).				Numbers.	Proportions.
<i>d.</i>				Millions.	Per cent.
2 and under	...	...	...	13.6	1.41
3	...	...	...	74.4	7.71
4	...	...	...	52.2	5.31
6 (and 7)	...	...	...	272.5	28.30
9	...	...	...	164.7	17.15
12	...	...	...	193.2	20.10
15	...	...	...	53.8	5.59
16 and 18	...	...	...	91.1	9.46
20	...	...	...	39.8	4.14
Over 30	...	...	...	8.0	.83
				963.3	100.00

It must be a surprising—one might be excused for using the word “startling”—result to find that 43 per cent. of the entire cinema admissions are in respect of seats for which the charge last year did not exceed 7*d.*, inclusive of Entertainment Duty, and this year did not exceed 6*d.*; and that another 37 per cent. paid not more than 1*s.* Nearly four out of every five persons visiting the cinemas pay not more than 1*s.* (including duty) for admission. When we shall have seen, as will be shown later, what is the actual duration of the programme presented to these visitors, and when there is added to this information the common experience of the character and the splendour of the modern structures, the comfort and brightness of the interiors, it is no extravagant language to say that the modern institution is one of the sociological wonders of the century.

A distinction—and it is a very important one—should be drawn between “persons” and “admissions.” Beyond recognizing its

existence I know of no means available at present for, even approximately, measuring this distinction. Many problems of policy—some public, some trade—would be carried far towards a solution if the frequency of cinema visits among the cinema-going population were known. The question of redundancy, to mention one example, might have a different importance if considered in relation to a population in which the cinema habit has such a hold that patrons of this form of entertainment go twice every week or only once every fortnight. In the first case the “fan” population would number only nine or ten millions; in the second it would approximate to the entire adult and adolescent population. Again, in the first case, further growth in attendances could probably be expected only by attracting those who now go only comparatively rarely to the cinema; and in the second case the same result would be achieved only by encouraging the “fans” to increase and multiply their present frequency of attendance.

Unfortunately, however, there is no available information which provides the slightest clue to an answer. If all cinema-goers were weekly visitors we know there would be nearly 19 millions of them. But it is a known fact that there is a number, not small, to whom the allure of the cinema is not satisfied by only one visit in each week. A large proportion of the country's cinemas regularly change their programmes twice every week because their profitable patronage is exhausted in three days, and only by changing their programmes, and so attracting a portion of their regular patrons to come twice in the same week, can they be made to pay. On the other hand, there must be considerable numbers whose average attendance is more nearly once every fortnight or even less frequently.

Seasonal Fluctuations in Cinema Attendances.

Before leaving the subject of attendances, there is another question which is frequently put to which an authoritative answer has never been given. It is notorious that attendances vary with the months of the year. The oncoming summer in the months of May and June is associated with a sudden and smart decline in the number of those who resort to the cinema for entertainment or relaxation. Cricket, tennis, outdoor sports generally, hiking, cycling and motoring become powerful counter-attractions bringing gladness to the public and depression to exhibitors. Many of these exhibitors would like to experiment with improved programmes and outstanding attractions with which they believe they could “beat the weather.” But, alas, this recourse is not open to them. Exhibitors can choose only from such films as the renters (*i.e.* distributors) propose to release from those which are available. Those renters

who distribute a large number of films each year—say 30 or more—habitually rearrange the films which would normally be released in the summer months so that the best of these might be released in the months of August and September, whereas the less attractive films of these months are brought forward as far as possible for release in the summer months. In the case of the smaller renters distributing, say, 26 pictures or less, the tendency is to avoid altogether the summer months and arrange the release dates for their films accordingly. The net effect of these combined forces is to aggravate the depression of the exhibitors' returns which would have followed from either force acting alone. At the same time it leaves the question unanswered as to whether the depression in the summer months is due to unfavourable cinema weather or to the showing of films that do not attract, or whether the higher returns of the winter months are caused by favourable cinema weather or the pull of the important films. This leads to the supplementary question: If the best films were released in the summer months and the less attractive films in the winter months, would the annual returns be adversely affected? The problem is easily posed; an answer cannot be readily given.

The complaints referred to in the last paragraph emanate principally from so-called "first-run" exhibitors, that is, those exhibitors who habitually show new films first in their respective areas. Other exhibitors in these areas are found showing the same films from one to three months later. They may, in fact, find themselves showing good and attractive films while their more important first-run competitors and leaders are showing inferior attractions. An enquiry among these exhibitors would probably prove that the adverse reaction on their box-office receipts of the June and July weather was less serious for the second-runners than among the first-runners. The problem is one of very great importance, and ought to be closely investigated by the Trade. It is possible that a "release" policy might be evolved which would increase the annual "grosses" materially over the amounts produced by the existing policy.

The actual seasonal variations—whatever the cause or causes—can, however, be indicated by the following method. I have been supplied, from an authority which can be accepted as very well informed on such a subject, with the percentage of the total receipts in 1934 from the Entertainment Duty on cinemas collected in each month. If the assumption is made, which is in my opinion a reasonable and legitimate assumption, that the average prices for admission during the year are approximately the same, the percentage changes in the yield of the duty would be the same as for the number of attendances. It is necessary, therefore, to correct the monthly

figures for the number of week-days (*i.e.* excluding Sundays, Good Friday and Christmas Day) to which they respectively apply, and the result will then be proportionate to the normal weekly admissions during every month of the year 1934. These corrections and calculations have been made with the results shown in the following table.

TABLE III.

Estimated Average Weekly Cinema Attendances during each Month of 1934.

				Percentage of Receipts from Entertainment Duty.*	Estimated Average Weekly Attendances.
					Millions.
January	...	...	...	9.3	21.8
February	...	...	...	8.0	18.6
March	...	...	...	9.2	18.5
April	...	...	...	8.9	21.2
May	...	...	...	7.8	16.9
June	...	...	...	7.3	13.8
July	...	...	...	5.6	14.6
August	...	...	...	9.0	17.8
September	...	...	...	8.6	20.9
October	...	...	...	9.2	20.7
November	...	...	...	9.5	18.2
December	...	...	...	7.6	19.4
				100.0	18.5

* The figures in this column are for months ending on the last Friday, and relate generally to cinema attendances up to the previous Saturday night. Where there are five Fridays, therefore, the months consist of 35 days; in the remaining cases the months are of 28 days. Sundays, Good Friday and Christmas Day are deducted to give the final number of weekdays.

The best months are very clearly evident. January comes first, followed by April, September, October and December. A marked depression was observable in the months of June and July. In these months the weekly attendances dropped to from 14 to 14½ millions a week, which is only 75 per cent. of the annual weekly average and only 64 per cent. of the January average.

Striking confirmation of the extent of the seasonal variation in average admissions and takings indicated in Table III is provided by some figures kindly supplied to me which have been prepared from returns of quarterly receipts for about 360 theatres of various grades and in various localities throughout Great Britain. The resulting figures have been rearranged by me so as to permit comparison between the returns directly received from the cinemas, and the returns used for Table III, and are as follow :—

Quarters Ending				Table III Figures.	Direct Enquiry from 369 Cinemas.
March 31	...	...	...	100	100
June 30	...	...	...	90.5	88.1
September 30	...	...	...	85.4	90.5
December 31	...	...	...	98.6	98.1

The closeness of the agreement between these two sets of figures justifies the conclusion to which they point as being broad-based on fact.

Cinemas and Seats.

I pass now to the subject of number, size and distribution of the cinemas throughout Great Britain. As this is the first time that an enquiry of this nature has been undertaken, the method adopted is explained. There are two Trade directories—the *Kinematograph Year Book* and the *Cinema Buyers' Guide*—each purporting to give a complete list of the names and addresses of all the cinemas throughout the British Isles, and in a very large number of cases the number of seats, and the system of sound-reproduction equipment employed. The names and addresses are, of course, likely to be accurate though possibly incomplete, but by a comparison of the two lists a third list was prepared which was regarded as sufficiently complete and exact for a first approximation to the facts. The figures for seats, where given, are less reliable, there being a tendency in some cases to inflation (owners declaring their cinemas to be larger than in fact they are) or to the use of round numbers (a 1,600-seater being sometimes described as having 2,000 seats). A check on these figures was, however, available by referring to the companies supplying the sound-reproduction equipment to the various cinemas. The installation of this equipment is always preceded by an acoustic survey, which includes a report of the number of seats. The preliminary complete list, prepared as described, was then broken up into four separate lists according to the sound equipment supplied respectively by the four principal companies in this branch of the business. Each of these companies was asked to check the "seating" in the list of cinemas as far as shown. They readily accepted the invitation and co-operated to the fullest extent possible. In the result I was left with a list which is probably substantially accurate as to seating for more than 90 per cent. of the cinemas in the country. Any error in the remaining 10 per cent. is not likely to be so large as to affect the conclusions of the tables following.

Table IV sets out the number of cinemas throughout Great Britain at the end of 1934 and the corresponding number of seats. The districts into which the country is divided are approximately

the same as the territorial units which have become established by the film renter (*i.e.* distributor) companies for the effective sale, service and supply of films to exhibitors.* The principal difference is that in certain cases the renters' territories cut through counties;

TABLE IV.

Number of Cinemas and Seats in Various Areas of Great Britain at end of 1934.

District.			No. of Cinemas.	No. of Seats.
				(100's omitted)
1. London (Postal area)	...	...	401	462
2. Home Counties	...	...	343	295
3. Eastern Counties	...	...	227	171
4. West of England	...	...	369	268
5. Midlands	...	...	585	501
6. Yorkshire and District	...	...	534	475
7. Lancashire and District	...	...	699	684
8. North of England	...	...	304	262
9. North Wales	...	...	62	42
10. South Wales	...	...	259	201
11. Scotland	...	...	522	511
Total: Great Britain			4,305	3,872

the respective territories in the above table comprise the whole of two or more counties.

It appears from the foregoing table that there were, at the end of 1934, about 4,305 cinemas in Great Britain containing 3,872,000 seats, or an average of 900 seats each. Adopting an estimated total population of 45½ millions in 1934 there was a cinema for every 10,600 persons (men, women and children) and one cinema seat to every 12 persons. If, as before, the children of less than 15 years are excluded, these figures become 7,940 and 9 respectively. I do not know the number of legitimate theatres and music-halls in the country, but if they were available the comparison would be very striking.

It would be difficult to quote another figure more eloquent of the hold which the cinema now has on the masses of the population. Cinemas are of two main classes—those which, generally, run the same programme on six days each week (excluding Sundays), and the others which change their programmes every three days. In the large majority of cinemas the three-day change of programme prevails. Both these categories of houses can be further divided into those which are open only in the evenings (commencing at 5.30 p.m. to 6 p.m.) and those which open earlier (commencing at about 12 noon to 2 p.m.). Those opening in the evenings only are again

* Appendix I.

in a considerable majority, though many of these add one, two or three matinée performances each week. There are a number of cinemas which change programmes more frequently than at three-day intervals and there are also occasional exceptional pictures when the same programme is run for more than a week—perhaps two, three or even four weeks. But the number of these is in both cases relatively negligible. Assuming, therefore, that all the houses are open only in the evenings and run their programmes twice daily and for runs of three days, the number of seats available could accommodate two-thirds of the entire population aged 15 and over each half-week. Reference will have to be made in the course of the paper to the question of redundancy, which is a complaint that is keenly agitating the minds of established cinema owners, who seriously contend that a halt should be called to the building of further cinemas. It must be admitted that, superficially at any rate, the figure of seating does give some colour to the contention that the existing facilities are adequate and that practically all who wish to visit a cinema can have no difficulty in satisfying their craving. This superficial argument must, however, be modified by various considerations, such as accessibility, comparative attractiveness of the accommodation provided, prices of seats, and the character and details of the programmes. Each of these considerations points in the direction of a larger number of houses from which the cinemagoer can make his choice. It is probable indeed that one of the most valuable contributions to the exceptional popularity of the cinema is the existence of a power of selection among alternative programmes in various accessible houses.

My next table contains an analysis of the number of cinemas classified according to the number of seats in each.

TABLE V.

Number of Cinemas in Great Britain Classified by Number of Seats (end of 1934).

Size of Cinema in Seats.	Cinemas.		Aggregate Seats.	
		Per cent.	No. (thous.).	Per cent.
500 or less	901	20.9	371	9.6
501- 600	470	10.9	268	6.9
601- 700	460	10.7	307	7.9
701- 800	460	10.7	352	9.1
801- 900	399	9.3	352	9.1
901-1,000	395	9.2	381	9.8
1,001-1,500	764	17.7	939	24.3
1,501-2,000	307	7.1	537	13.9
2,001 and upwards ...	149	3.5	365	9.4
Total	4,305	100.0	3,872	100.0

The facts disclosed in this table were not expected. The existence of small cinemas is, of course, not unknown. But the general view of the cinema has been formed and is maintained by the large, brightly-coloured, brilliantly-illuminated picture palaces, built and building, which are the constant experience of those who live in London and the large provincial towns. To all these the surprise must be profound when asked to credit the information that more than one-half the seating accommodation in the cinemas throughout the country will be found in houses containing less than 1,000 seats, and that the number of these houses is more than 70 per cent. of the total. A summary table (corrected, as in Table V, by distributing the theatres with "seating unknown" *pro rata* among the smaller houses of not more than 1,000 seats) is as follows:—

TABLE VI.

Summary of Number and Seating of Small and Large Cinemas.

Size.	Houses.		Seats.	
	No.	Per cent.	No. (thous.).	Per cent.
Small—(1,000 and under)	3,085	71·4	2,031	52·5
Large—(over 1,000) ...	1,220	28·6	1,841	47·5
Total	4,305	100·0	3,872	100·0

Five out of every seven cinemas provide not more than 1,000 seats each and the remaining two-sevenths provide the balance of nearly one-half of the total seating in the country. In any scientific study of the economics of the industry the too-frequently forgotten distinction between the "small" and "large" houses will be found vitally important. Whether the line should be drawn sharply at 1,000-seaters or at a somewhat smaller house it is impossible to say, but, wherever the line is drawn, the broad conclusion will be the same. That conclusion was summed up as follows in the letter sent by the Cinematograph Exhibitors' Association last February to the Chancellor of the Exchequer on the subject of the Entertainment Duty:—

"So much space in the daily newspaper is given to the operations of the large cinemas, and the large circuits of large cinemas, that an impression of general prosperity is undoubtedly credited in the public mind, and perhaps also in your mind. Such an impression is an entirely erroneous one if it creates the belief that both large and small cinemas and groups of cinemas are enjoying any identity of trading experience."

There may be, of course, contributory causes other than mere size for the comparative unsuccess of the smaller houses in recent

years. My own observation of the new building programmes, which would probably be confirmed by very close enquiry, leads to the conclusion that more than one-half of the cinemas under construction are of the 1,000-seater or more type. It is probably true also that nearly all the smaller theatres are old—at least ten years or more. The smaller houses are on the whole much less comfortable and structurally less well adapted for the satisfactory reproduction of sound which, since 1929, has become an indispensable requisite of the cinema. Briefly, then, the conflict—where it exists—between the “small” and the “large” cinema is between new and obsolete, or obsolescent, types with the usual consequences in such a conflict. Nevertheless, the struggle will go on, and the “will to live” among proprietors of the smaller houses deserves respectful sympathy from the public. Probably more than £20 million were invested in them, and their replacement by the newer types now in favour could not be undertaken at a cost of less than twice this figure. The cinema’s industrial revolution which followed on the introduction of “talkies” bore with exceptional severity on a large proportion of the smaller houses, and the cost of adaptation to the new acoustic standards left them often crippled and without resources to enable them to finance the progressive improvement in the standard of cinema construction which has been a marked feature of the last five years.

My next table contains an analysis of the cinemas in Table IV classified according to the number of seats contained in them, and the districts in which they are situated.

TABLE VII.

Number of Cinemas, Classified by Means of Seats in each Cinema, in Different Districts (end of 1934).

District.	Size of Cinema (in seats).									Total.
	0-500.	501-600.	601-700.	701-800.	801-900.	901-1,000.	1,001-1,500.	1,501-2,000.	2,001-.	
1. London (Postal area) ...	63	40	34	39	25	21	68	59	52	401
2. Home Counties ...	97	44	33	23	26	28	50	32	10	343
3. Eastern Counties ...	88	25	24	17	12	12	33	13	3	227
4. West of England ...	143	60	36	31	17	25	31	19	7	369
5. Midlands ...	124	56	69	79	58	45	109	36	9	585
6. Yorkshire and District ...	83	61	59	63	70	59	97	26	16	534
7. Lancashire ...	95	60	66	75	74	94	160	50	25	699
8. North of England ...	49	33	32	38	38	32	64	15	3	304
9. North Wales ...	27	8	6	4	7	2	6	2	—	62
10. South Wales ...	59	38	38	45	24	17	27	8	3	259
11. Scotland ...	73	45	63	46	48	60	119	47	21	522
Total ...	901	470	460	460	399	395	764	307	149	4,305

As might have been expected, the range of difference in the relative sizes of cinemas in various districts is considerable. In areas mainly rural and agricultural, as well as in industrial areas associated with the recent exceptional figures of unemployment, the small cinema continues to be the predominant type. In London, as in the other areas containing the larger urban centres where economic recovery has been in advance of the rest of the country, the larger houses are the prevailing type. For example, in the London Postal area containing 401 houses, no fewer than 111 or 27½ per cent. have more than 1,500 seats each. On the other hand, in the Eastern Counties and in the West of England the number of these houses is between 6 and 7 per cent. of the total. Intermediate between these figures come the Yorkshire area (8 per cent.), the Lancashire area (11 per cent.) and Scotland (13 per cent.). The comparative frequency of the larger type of cinema in Scotland is specially interesting, and confirms the general experience in the trade that in Scotland the vogue of the cinema has reached a higher pitch than in any other part of the country outside the Metropolis. It is difficult to account for the difference in this respect between Scotland and, say, Lancashire, where comparatively large concentrations of population are more frequent. Perhaps the Scotsman's reputedly keener sense of values is more completely satisfied by the larger type of house, and the enterprising proprietors feel it good business to cater to this sense. These comparisons apart, some degree of surprise must be aroused by the generality of the distribution of the large proportion of small houses. In London more than 25 per cent. of the cinemas are of less than 600 seats each; in the Home Counties the proportion is more than 40 per cent.; in the Eastern Counties and in the West of England it is nearly 50 per cent.; and so on in various degrees elsewhere. This frequency of the small cinema is, no doubt, very largely a relic of the older days of the industry, when building was undertaken in a spirit of great cautiousness and without the assured confidence prevailing to-day in the permanence of the cinema taste among the general public and its freedom from exceptional "risks" as an investment. While this fact may explain the present prevalence of the small type of house, it is nevertheless the fact that it conflicts with the impression of nine out of ten members of the general public. To them, taught and misled by the experience gained from parading the principal thoroughfares of the towns in which they reside, it must come as a shock that the small cinema is the rule and the large one the exception.

A more informing statement of the facts, as between the small and large houses, is conveyed by the distribution of seats rather than by the number of houses in different districts distinguishing again

between houses of various sizes. This information is supplied by my next table (Table VIII).

Assuming seats, and not cinemas, in each district more accurately indicate the provision of opportunities for cinema entertainment, this table is very illuminating. In the London area, it is now seen, more than one-half of the seating accommodation is found in houses

TABLE VIII.

Number of Seats, Classified by Sizes of Cinemas, in Different Districts (end of 1934).

District.	Seating (in thousands).									Total.
	0-500.	501-600.	601-700.	701-800.	801-900.	901-1,000.	1,001-1,500.	1,501-2,000.	2,001-.	
1. London (Postal area) ...	25	23	23	30	22	20	85	104	130	462
2. Home Counties ...	38	25	22	17	23	27	64	56	24	296
3. Eastern Counties ...	35	14	16	13	10	12	41	23	7	171
4. West of England ...	58	34	24	24	14	24	39	34	16	267
5. Midlands ...	51	32	46	60	50	43	137	61	20	500
6. Yorkshire and District ...	35	35	39	48	61	57	117	44	40	476
7. Lancashire ...	43	34	45	57	72	90	194	89	60	684
8. North of England ...	19	19	21	29	33	31	77	26	7	262
9. North Wales ...	12	4	4	3	6	2	8	3	—	42
10. South Wales ...	26	22	25	35	21	17	33	14	9	202
11. Scotland ...	30	26	42	35	41	58	143	83	53	511
Total ...	372	268	307	351	353	381	938	537	366	3,873

of more than 1,500 seats each. In Scotland the figure is 28 per cent., in Lancashire 22 per cent. and in the Midlands 18 per cent. At the other end of the scale it is now notable that only 10 per cent. of the cinema seating is provided in London and Scotland respectively in houses not exceeding 600 seats; in Lancashire the proportion is 11 per cent., whereas throughout Wales it is more than 25 per cent., and in the West of England it reaches 32 per cent. The two latter areas can be accurately described as the special home of the small cinema.

The range of variation is obviously considerable and is simply and compendiously indicated in the following table showing the proportions of the total seating accommodation in each district, provided by houses of not more than 1,000, 1,001-1,500, and more than 1,500 seats respectively.

The proportion of small houses varies from 31 per cent. in the London area to over 70 per cent. in Wales (North and South), closely followed by the West of England with 66 per cent. After London,

TABLE IX.

Proportion of Seat Accommodation in Different Districts in Small, Medium and Large Houses (end of 1934).

District.	Small (1,000 seats and under).	Medium (1,001–1,500 seats).	Large (1,501 seats and upwards).
	Per cent.	Per cent.	Per cent.
1. London (Postal area) ...	31	18	51
2. Home Counties ...	51	22	27
3. Eastern Counties ...	58	24	18
4. West of England ...	66	15	19
5. Midlands ...	57	27	16
6. Yorkshire and District ...	57	25	18
7. Lancashire and District ...	50	28	22
8. North of England ...	58	29	13
9. North Wales ...	73	19	8
10. South Wales ...	71	17	12
11. Scotland ...	45	28	27
Great Britain ...	53	24	23

the largest proportion of seats in houses with more than 1,500 seats each, is to be found in the Home Counties, Scotland and Lancashire. The medium size of house is found in greatest abundance in the counties between the Trent and the Tweed.

Cinema and Seating in Relation to the Population.

Turning from the distribution of cinemas throughout the country, our next enquiry is into the relation between this distribution and the population. It is reasonable to expect that districts with a higher density of population will attract more and larger cinemas than those in which the communities are widely scattered and the density of population, therefore, comparatively low. There are, however, other possible causes of the actual distribution of cinemas. For example, the actual economic character and level of the people living in the district may cause notable differences in the distribution; whether it is a suburb of a prosperous town, or whether it is in itself or contiguous to a depressed area with a high level of unemployment, or in which the economic condition is below the average with no immediate prospect of improvement. Sometimes new cinemas are built for reasons dictated by what is known as "trade politics." Large circuits of theatres seem to feel they are not alive unless they give constant evidence of growth. To remain stationary is to stagnate. They have grown in numbers so rapidly that they have acquired a momentum which makes resistance to further expansion almost impossible, and additions of both old and new houses to their circuits take place continuously. The Gaumont-British Circuit—

the largest in this country—started in 1927 with only 20. The number of theatres owned and controlled by this Corporation, as shown in consecutive Annual Reports, have been as follows: (1928) 176; (1929) 299; (1930) 313; (1931) 331; (1932) 337; (1933) 337; (1934) 324; (1935) 331. I estimate that the number of seats in these cinemas is more than 410,000, averaging 1,240 each and representing 10·6 per cent. of all the seats in the country. Similarly, the Associated British Picture Corporation (formerly British International Pictures, Ltd.) started business in 1928 with a small group of 32 theatres. This number grew in later years as follows: (1929) 73; (1930) 120; (1934) 200; (1935) 225.

In both these cases, as also with other smaller circuits of from 20 to 80 theatres, the growth is largely a normal and understandable one. The characteristic of the cinema as a business is such that circuits of theatres expect to increase their purchasing power for pictures with every addition to their numbers, and up to a point each added house increases the purchasing power for the whole circuit. Economic readjustments, into which it is unnecessary to enter now, do, however, take place, which deprive the circuits of some of their expected gains, and something closely resembling the law of diminishing returns begins to operate. Two independent cinemas A and B may have been operating in such a manner that A is generally able to acquire certain pictures which B would be willing to show but is unable to do so in face of A's competition. The time arrives when A succumbs to the temptation of being bought out by one of the large circuits. The pictures shown in A will thenceforward be influenced by the circuit policy, and B will often find itself able to negotiate for the pictures formerly shown in A, and is further compensated by the disappearance of A's competitive offer for these pictures. Another political motive to theatre ownership is to be found in the desire of certain "renters" (i.e. distributors) to use cinemas located strategically in different parts of the country as "shop windows" for the pictures they are anxious to sell. Cinemas may be classified according to the order in which they play important pictures in their areas. The houses in which such pictures are first shown are known as "first run," those showing the same picture next—usually not before two weeks later—are known as "second run" houses, and so on. A picture which has proved a "winner"—as the showman describes it—in first-run cinemas is likely to be more successful, in second- and later-run houses, than one which attracts only moderate audiences. The owner of important pictures is therefore concerned that the first run shall be as successful as good showmanship can make it, and it is obvious, therefore, why ownership is sought by him of these first-run houses where the exploitation

and presentation are under his direct control. This is very notably the case with a company like the Paramount Film Service, who, in pursuit of their policy, have planted over the country a series of distinguished picture-houses from which it is claimed they have derived considerable indirect, as well as direct, advantage.

Cinemas and Population.

Although the motives for building new houses and their general distribution throughout the country may be many and mixed, it is, nevertheless, desirable to extend the enquiry to the relation between the number and seating of cinemas and the population to be served by them. In this analysis it would obviously have been better if the comparison could have been made with a 1934 population and so take into account the changes produced by the migratory streams that have been exceptionally active in recent years. This correction has, however, been found impracticable and the population figures used are those of the 1931 Census. As indications of general tendencies they are probably not misleading. Additional

TABLE X.

Distribution of Cinemas in Relation to the Population.

	Population (1931).		Cinemas.		Total Population.		Population aged 15 and over.	
	Total and over (thous.)	Age 15 (thous.)	No. of Houses	No. of Seats (thous.)	Pcr House (thous.)	Pcr Seat.	Pcr House (thous.)	Pcr Seat.
1. London (Postal area) ...	6,363	4,989	401	462	15.9	14	12.4	10.9
2. Home Counties ...	4,166	3,279	343	295	12.1	14	9.6	11.2
3. Eastern Counties	3,173	2,406	227	171	13.9	19	10.6	14.0
4. West of England	4,047	3,240	369	268	10.9	15	8.8	13.0
5. Midlands ...	6,133	4,597	585	501	10.5	12	8.1	9.6
6. Yorkshire and District ...	5,014	3,794	534	475	9.4	11	7.1	8.0
7. Lancashire ...	6,187	4,746	699	684	8.8	9	6.8	7.0
8. North of England	2,571	1,844	304	262	8.5	10	6.1	7.2
9. North Wales ...	532	406	62	42	8.6	13	6.6	10.7
10. South Wales ...	2,061	1,499	259	201	8.0	10	5.8	7.6
11. Scotland ...	4,843	3,538	522	511	9.3	9	6.8	6.9
Total ...	45,090	34,338	4,305	3,872	10.5	12	8.0	8.9

value to the table (Table X) is supplied by the addition of figures for population of fifteen years and upwards to those of total population.

The number of cinemas in proportion to the population varies between wide limits. In the London Postal area it is highest, reaching to 15,900 persons per cinema; from this figure it falls

steadily through England and Wales, and in the South Wales area the population per cinema is about 8,000 only, just about one-half of the average population per cinema in the London area. It is figures like these that lend most support to the strong current of opinion in the Trade, especially among exhibitors, that in many districts throughout the country enough cinemas exist already, and that further enterprises involving new cinemas should be prohibited, either by law or by the Trade, in some manner yet to be devised. Certainly the figures call loudly for comment. This question is discussed more fully later in this paper.

The cinema demands of the population in the London and adjacent areas are apparently satisfied by the erection and maintenance of one cinema for each 12,000-15,000 of the population. In the Midlands the figure falls to 10,800, in the Lancashire area to 8,800 and in South Wales to 8,000. The approach to the problem by the single path of the number of cinemas is possibly misleading. Information would be necessary as to the size of the cinemas, the distribution of the population in close proximity to the cinema, the proportion of this population of normal cinema-going age, the age of the cinema building or of its last reconstruction, its adaptability to sound reproduction, its ventilating and heating efficiency. In addition, also, information of the average amount of unemployment ruling in the district in recent years would have to be closely examined before any rational conclusion to such a difficult problem as degree of saturation could be reached.

Some of this further information is contained in the later columns of Table X. From this it appears that in the London area there is one cinema seat to every 14 of the entire population, and to 11 of the population aged 15 and upwards. In the Lancashire area the corresponding supply of seats is represented by the numbers 9 and 7 respectively, and in South Wales by 10 and $7\frac{1}{2}$ respectively. The disparity in various districts is, by this approach, shown to be very considerably diminished. If it were possible to make statistical allowance for comparative population density and for the differences in the number of hours the cinema is open, the average length of programme, and the number of programme changes each week, it might then be possible to reach a more rational judgment on this highly controversial Trade question. For example, a 1,000-seater in a provincial town, open nine hours daily and showing a three-hour programme, could cater for 3,000 admissions daily. In another district a 1,500-seater showing its programme twice daily could similarly cater for 3,000 persons. If the former changed its programme once each week it has a capacity of 18,000 admissions a week; but if the latter changed its programme twice weekly it could

also cater for 18,000 admissions, but only if many of the patrons visit the cinema twice weekly. This would probably depend largely on, among other considerations, the average distance which these patrons have to cover between their homes and the cinema. Much more evidence will have to be supplied by those who contend for restriction of new building schemes before the claim that over-building is taking place could be conceded.

An extremely interesting question, bearing on the general question of the relation of cinemas and their size to the density of the population, is answered in the following table (Table XI).

TABLE XI.
Percentage of Cinemas of Different Sizes in Relation to Density of Population in Different Areas.

District.	No. of Seats.									Density of Population per sq. mile.
	0-500.	501-600.	601-700.	701-800.	801-900.	901-1,000.	1,001-1,500.	1,501-2,000.	2,000-	
	Average Seating.									
	410.	571.	670.	700.	887.	961.	1,250.	1,750.	2,150.	
Scotland ...	13.4	8.4	11.6	8.6	8.8	11.0	21.3	9.6	4.3	163
North Wales ...	12.5	13.0	9.3	5.6	11.1	3.7	11.1	3.7	—	163
West of England	3.2	15.9	9.7	8.2	4.4	6.8	9.1	5.6	2.1	380
Eastern Counties	38.8	10.7	10.3	7.6	5.4	5.4	14.7	5.8	1.3	431
South Wales ...	22.4	14.5	14.5	17.4	9.4	6.7	10.7	3.2	1.2	440
North of England	16.0	10.9	10.5	12.2	12.2	10.2	21.7	5.1	1.2	487
Yorkshire and District	15.5	11.1	11.0	11.8	15.0	11.2	18.3	4.7	3.1	594
Midlands	20.2	9.1	11.8	13.7	10.0	7.7	19.3	6.6	1.6	710
Home Counties	28.2	12.7	9.4	6.8	7.7	8.0	14.8	9.1	3.0	794
Lancashire	15.5	8.8	9.5	10.6	10.4	13.5	23.0	7.1	3.6	2,157
London (Postal area) ...	15.5	10.0	8.4	9.5	6.1	5.3	17.1	15.0	13.1	27,330
Correlation Coefficients ...	-0.413	-0.373	-0.256	+0.136	+0.161	-0.619	+0.402	+0.226	+0.404	

In this table the proportion of seats in each district found in houses classified according to the seats they respectively contain is shown in relation to the corresponding density of the population in those districts. It will be seen that, as the population-density increases, the proportion of seats in large houses rises and in small houses falls. That is to say, the correlation is positive for large houses and negative for small ones. How close this correlation is can be determined only by working out the correlation coefficients.

The London area figures were excluded from this calculation because its population-density was so many times greater than that of any other area that the same law could not be assumed to determine the building of cinemas in London as throughout the rest of the country. In Scotland, inhabited by 163 persons per square mile, 13.4 per cent. of the total seating is found in small houses of 500 seats and under, 11.0 per cent. in houses of 900-1,000 seats each, and so on. The figures in these large areas are somewhat disturbed by the presence of large and thickly populated towns like Glasgow, Edinburgh, Dundee and Greenock. In the Yorkshire district, where the density of population is 594 per square mile, there is to be found 26 per cent. of the entire cinema seating in houses of 1,000 seats and upwards; in the Lancashire district, where the density has increased to 2,157 per square mile, the corresponding percentage rises to nearly 34.

The correlation coefficients between each column of "percentages" and population density are given at the foot of the table. These strikingly confirm all expectations, the coefficients changing in sign as we proceed from small to large houses, and establish the law that as the density of the population increases the percentage of the total seats to be found in large houses will show a corresponding increase.

New Cinemas and the Problem of Redundancy.

It is desirable and appropriate, at this point, to refer to the question of new cinema construction in recent years and to the very vexed and difficult question of so-called redundancy. A regular reader of the Trade papers could not fail to be greatly impressed with the frequency of the complaints all over the country at the steady and irresistible pressure of the advancing wave of new cinemas—larger, more comfortable, more conveniently located, and intensively competitive both for audiences and for films—threatening completely to overwhelm the exhibitors already established in every important district. No surprise need be felt that the desire to prevent this increasing competition should exist among exhibitors threatened by it. They recall with truth the years of service they have performed in their neighbourhoods, the burden involved on them in complying with building and fire-prevention regulations, the comparatively large capital invested in their cinemas; and urge these as sufficient reason for demanding, from Parliament or from the local Licensing Authority, support in suppressing or restricting new construction. Failing to get any effective response from these quarters they hope to succeed better by appealing to the distributors to withhold supplies of films, and so help in checking the growth

of these new theatres. But exhibitors should ask whether this restriction would be in the public interest. Such a question is, perhaps, superfluous, because unless public support is forthcoming the new adventure will fail, and the investment in it would be jeopardized; and in these days it is not regarded as anybody's business to prevent any investor from making a fool of himself. In fairness to the exhibitor, however, it should be said that the answer to this contention is, that once built the new houses will remain for a considerable time, performing little or no useful new service to the community, not attracting paying audiences themselves, and succeeding only in causing permanent injury to all the established houses with which the new ones compete.

There is possibly a certain amount of truth in these complaints. But the demands, in the form being put forward by exhibitors, are virtually for recognition of the cinema as a monopoly or quasi-monopoly. New construction in theatres is, as in most other industries, evidence of the constant urge for progress. More than in most industries the cinema has improved, is improving, and will continue to improve in its power of attracting the public. Architectural, structural and other improvements are being constantly devised and added in the newer types of buildings, and it is unlikely that parliamentary or municipal legislation will be enlisted in favour of checking this kind of enterprise.

If exhibitors pressed their claims for restriction solely on the grounds of the number of houses and seats already existing in any area it is possible that very little sympathy would be developed either among the public, the local authorities or in Government Departments. A different attitude might, however, with some reason and justice, be adopted if the special trading conditions now prevailing are taken into account. The exhibitor, unlike most other traders, is not free to provide his patrons with the programmes of his choice. Owing to the growth and power of circuits, large and small, he can only choose a programme from a fraction, sometimes only a small fraction, of the films ready for showing. A one-theatre proprietor in a neighbourhood of theatres belonging to a group or circuit of theatres under the same ownership is often compelled to show only the least attractive films because the larger companies exert their greater booking power to reserve the better and best pictures for themselves. The deprivation of this freedom of choice of the subjects he would like to play in his cinema, which becomes increasingly stringent with every theatre built by, or added to the control of, existing circuit proprietors, is the principal, perhaps the only, rational justification for any claim to relief. Such a claim could with some propriety be urged in those cases where new theatres

are built or required by a company already owning or controlling a group of theatres. It applies with much less force in those cases where the new cinema is expecting the support of patrons solely on the individual merits of the theatre, its management, and its service.

By the courtesy of the Western Electric Co. I have been supplied with a list of new theatres opened since January 1st, 1932. With the aid of the Cinematograph Exhibitors' Association I have been able to complete (with a few exceptions) the seating accommodation for this list of theatres. All this valuable information will be found summarized in the following tables (Tables XII and XIII), which do, at any rate and whatever our views on redundancy, provide an exact measure of the general features of the problem.

The first of these tables (Table XII) gives a summary of the number of new theatres in Great Britain.

TABLE XII.

New Cinemas, Classified by Seats and Districts, Built in Great Britain since Jan. 1st, 1932.

District.	0-500.	501-600.	601-700.	701-800.	801-900.	901-1,000.	1,001-1,500.	1,501-2,000.	2,001-2,500.	Un-known	Total.
1. London (Postal area) ...	6	1	-	-	1	-	2	3	10	1	24
2. Home Counties ...	4	2	1	3	8	11	10	18	6	-	63
3. Eastern Counties ...	8	2	2	4	1	1	2	4	4	1	29
4. West of England ...	8	4	2	3	2	5	7	3	2	3	39
5. Midlands ...	4	1	-	2	2	3	13	7	2	3	37
6. Yorkshire and District ...	-	1	3	-	1	1	8	3	2	1	20
7. Lancashire ...	1	-	-	1	1	3	10	4	2	2	24
8. North of England ...	1	-	2	2	2	1	3	3	2	1	17
9. North Wales ...	-	1	3	-	-	-	1	1	-	-	6
10. South Wales ...	1	-	1	1	-	1	-	-	-	-	4
11. Scotland ...	3	2	3	3	1	-	13	9	3	2	39
Total ...	36	14	17	19	19	26	69	55	33	14	302

This shows that since January 1st, 1932, the new cinemas built have numbered 302. Of these, 87 are to be found in the London Postal area and the Home Counties, 39 in the West of England, 37 in the Midlands and 39 in Scotland. Out of the 288 new cinemas whose seating capacity is known, no fewer than 88 or more than 31 per cent. of the total have more than 1,500 seats each, and 86 have *not* more than 800 seats each. These figures, it will be shown, are totally different from the distribution by size of the existing cinemas, and prove how great is the tendency for the construction

of large cinemas at the present time compared with the practice of former days.

Another aspect of the same movement is provided by the following table (Table XIII), which shows the total number of seats in these new cinemas classified according to the sizes of the cinemas themselves.

TABLE XIII.

Number of Seats, Classified by Sizes and Districts, in Cinemas Built in Great Britain since Jan. 1st, 1932 (00's omitted).

District.	0-500.	501-600.	601-700.	701-800.	801-900.	901-1,000.	1,001-1,500.	1,501-2,000.	2,001-.	Total.
1. London (Postal area) ...	1.6	6	—	—	9	—	2.7	5.5	24.9	36.2
2. Home Counties ...	1.7	1.1	7	2.4	7.0	10.8	12.9	30.6	14.8	82.0
3. Eastern Counties ...	3.2	1.1	1.3	3.0	8	1.0	2.8	7.6	9.4	30.2
4. West of England ...	3.6	2.3	1.3	2.2	1.8	4.9	9.6	5.4	4.1	35.2
5. Midlands ...	1.7	5	—	1.5	1.8	3.0	16.9	11.1	4.6	41.1
6. Yorkshire and District ...	—	6	1.9	—	9	9	9.7	5.3	5.1	24.4
7. Lancashire ...	4	—	—	7	9	2.9	12.3	7.7	4.7	29.6
8. North of England ...	5	—	1.4	1.5	1.8	9	3.6	4.8	4.7	19.2
9. North Wales ...	—	5	2.0	—	—	—	1.0	1.9	—	5.4
10. South Wales ...	5	—	6	8	—	1.0	—	—	—	2.9
11. Scotland ...	1.4	1.2	2.0	2.4	—	—	15.0	15.9	7.4	45.3
	14.6	7.9	11.2	14.5	15.9	25.4	86.5	95.8	79.7	351.5

The importance of the larger houses in the cinemas of recent construction is here more apparent. The total number of new seats is 351,500 and represents 9 per cent. of the total now existing in Great Britain, and of this total nearly 50 per cent. are to be found in houses of more than 1,500 seats. The London and Home Counties have contributed most to this result, the figures being 75,800 out of the total of 175,500, or 43 per cent. of this total. Scotland also is a comparatively large contributor to these new totals, the figures showing that 23,300 seats have been installed in houses of more than 1,500 seats each out of a new total of 45,300 Scottish seats. The comparative increases of new cinema constructions are more clearly brought out in the next table (Table XIV), which sets out in parallel columns the new seats and the total number in existence at the end of 1934.

In the London Area (London and Home Counties) the new seats amount to 15.7 per cent. of the total, a figure which is exceeded by the Eastern Counties and approached by the Western Counties. These are all areas (cp. Table X) in which the existing seating is lower than the average for the country as a whole. On the other hand, in Lancashire and Yorkshire, where the seating-density is

higher than the average, the new constructions appear to be at a much lower average rate than for the whole country. This might, of course, have been anticipated if other contributory causes could be ignored. But ought we not to take into account the relative economic conditions in these areas? The Northern Counties are known to have passed through a period of exceptional distress, and even now have recovered less in amount and later in time than in the London areas. Can the economic conditions be altogether overlooked in accounting for the differences in building schemes? Would it not be more reasonable to suppose that the comparative scarcity of seats as well as the degrees of unemployment (the latter as an index of economic prosperity) are joint contributors—in different degrees, perhaps—to the result?

TABLE XIV.

Comparison of New Seats added since Jan. 1st, 1932, and Total Seats at end of 1934 in Different Districts of Great Britain.

District.	Total Seats at end of 1934.	New Seats since Jan. 1st, 1932.	Ratio of New Seats.
	(thousands)	(thousands.)	Per cent.
London and Home Counties ...	757	118	15.6
Eastern Counties ...	171	30	17.5
West of England ...	268	35	13.1
Midlands ...	501	41	8.2
Yorkshire and District ...	475	24	5.1
Lancashire and District ...	684	30	4.4
North of England ...	262	19	7.3
North Wales ...	43	5	1.2
South Wales ...	201	3	1.5
Scotland ...	511	45	9.2
Great Britain ...	3,873	352	9.1

Sunday Opening of Cinemas.

The Sunday Entertainments Act of 1932 was passed by Parliament in order to permit the opening of cinemas on Sundays. This permission, which the Courts had decided was prohibited by the provisions of the Sunday Observance Act of 1780, was by the new Act delegated to the Local Authorities, and some interest attaches, therefore, to the extent to which this new right has been exercised. Although Sunday opening is now fairly widespread, it is far from being general. It has never been the subject of any official campaign by the trade, because a large body of exhibitors always have been, and are still, opposed to opening their cinemas on Sundays. This opposition of exhibitors is not the product of any exceptional amount of religious ascetism among them as a class. They are, in

fact. no more religious than the rest of the community. It is due solely to their conviction that the whole of their cinema patronage is satisfied by six days a week, and that opening on Sundays would merely reduce their Monday admissions by an almost exactly equal amount. The Act excepts Scotland from its operation.

The County Councils are in the first instance the Licensing Authority under the Cinematograph Act, 1909, and although they may delegate such powers, in general they retain the control in their own hands. The majority of County Councils have always been opposed to the Sunday Opening of Cinemas. Machinery was introduced whereby an Urban District Council, and a Rural District Council, could pass a resolution to apply to the Home Secretary for a draft Order, with procedure for a public poll. The Home Secretary issues the draft Order to the County Council which thereupon issues the Sunday Opening Licence for that Urban District area. In consequence many Urban District Councils and Rural District Councils, which previously were dependent upon the over-riding authority of the County Council, can now be approached. The introduction of a poll also facilitates discussion by Urban District Councils and Rural District Councils. Formerly they had to accept responsibility for a decision. As a poll now invariably follows many have felt that they can pass the responsibility to the local government electors. Generally, wherever there is a floating population to be catered for on Sunday evenings there is a demand for Sunday Opening, although this generalization does not represent the entire extent of the demand.

So far as I can ascertain, however, the total number of houses in England and Wales which open on Sundays amounts to 874, of which 282 are in the London County Council area, and 208 in Middlesex, Surrey, Essex and Kent. Of the balance, Warwick has given permits to 100 cinemas, Hampshire to 66, Durham to 55 and Lancashire to 48. All the rest of the country accounts for the balance of 115. At the present time, therefore, Sunday opening exists in about 23 per cent. of the cinemas in England and Wales, with about 850,000 to 900,000 seats.

Hours Open Daily.

Reference has already been made to the fact that the bare statement of the numbers of cinemas and seats in different parts of the country gives an incomplete and often inaccurate view of the possible numbers of the public for whom this class of entertainment is provided. Quite obviously the time during which the cinema is open each day must also be taken into account. A house with 1,500 seats open nine hours daily is presumably capable of entertaining a much larger public than a 2,000-seater open for less than five hours daily.

Presumably—but not necessarily. The former might be presenting three programmes daily, and is capable, therefore, of playing to a maximum of 4,500 persons. The latter might be showing two programmes daily and capable, therefore, of playing to 4,000 persons. Such a comparison implies “full houses” from opening to closing time, a condition less likely to be fulfilled in the cinema opening early than in the one opening late.

Cinemas in London have been known to open their doors at 10 a.m. and close at 12.30 a.m. : others open about noon and close at 11 p.m. There is greater uniformity in daily-opening hours in the provinces, and they substantially group themselves into two principal categories—the one in which the opening hours are from about 2 p.m. to nearly 11 p.m., and the other in which the houses open about 5.30 p.m. to 6 p.m. and close at about 11 p.m., or maybe a quarter of an hour earlier. The former will, probably, run its programme, averaging three hours, three times and the latter its programme of about 2½ hours’ length twice daily.

The attendances at the cinema—apart from the exceptional attractiveness of certain pictures—vary between very wide limits during each day and at different times of the year. Although it is possible, as will be shown immediately, to calculate the average number of hours the cinemas in any area are open daily and weekly, it is not possible, without knowledge of the average duration of each programme, to form any estimate of the ratio of admissions to total audience capacity in those areas. This information is not likely to be forthcoming without a house-to-house (*i.e.* cinema-to-cinema) canvass of the length of programme being shown. It is possible, however, and the method is reproduced here because it appears to have some interest, to give an estimate of the average number of hours daily during which cinemas are open to the public in different parts of the country. The method is based on the fact that since “talkies” arrived, the speed at which all film passes through the sound-reproduction equipment has had to be standardized; otherwise the pitch of the sound would rise or fall with the speed. The standard speed has been fixed at 24 pictures or 1½-ft. per second, which is equal to 11·1 minutes per 1,000 ft. or 5,400 ft. per hour. If the total length of the films passing through the theatre projectors in the year were known, a simple arithmetical calculation would give the average number of hours daily during which the theatre has been open to the public.

How can the average length of the film run through the machines be ascertained? Very simply; by asking the Board of Trade to tell you. Under the Cinematograph Films Act, every exhibitor must send a return to the Department, by means of which the exhibitor’s

performance or default of his quota obligation can be checked. This return contains precisely the information required for the calculation. The Department were good enough, at my request, to tabulate the information for a sample of 425 cinemas distributed over Great Britain, numbering about 10 per cent. in each territory into which the country has been divided for the present paper. The following is a summary of this return.

TABLE XV.

Average Length of "Registered" Film run by Exhibitors in Year ending September 30th, 1934 (in Million Ft.).

District.	Seating Capacity up to 1,000.		Seating Capacity over 1,000.	
	No. of Theatres.	Average Length (million feet).	No. of Theatres.	Average Length (million feet).
1. London (Postal area), ...	23	14.0	20	14.2
2. Home Counties ...	23	10.6	11	12.9
3. Eastern Counties ...	18	7.9	6	13.1
4. West of England ...	26	8.0	7	12.6
5. Midlands ...	42	7.1	16	10.6
6. Yorkshire and District	35	7.4	14	9.2
7. Lancashire ...	47	7.6	22	8.3
8. North of England ...	22	6.3	8	9.0
9. North Wales ...	6	5.7	3	7.0
10. South Wales ...	23	7.0	5	10.8
11. Scotland ...	27	6.6	21	9.9
Total ...	292	8.0	133	10.8

Some of the figures in the foregoing table are offered with a certain amount of reserve in consequence of the smallness of the samples upon which the calculations for certain districts have been based. The broad effects are, however, very marked and probably truthfully represent the conditions prevailing throughout the country. A distinction has been drawn first between large and small houses. The former type are naturally more frequent in the large than in the small towns, and therefore are likely to include a greater proportion of houses opening round midday. And this expectation is confirmed by the fact that for the country as a whole the small type of house used an average of 8.0 million feet a year, whereas the larger type used 10.8 million feet in the same time. Throughout the table the same kind of difference is shown, though the amount of this difference varies. In the London area, as would have been expected because practically all the houses in this area, large and small, open for the same time, the calculations show that substantially the same quantity of film has been run. But nowhere else is there the same kind of agreement. The figure falls to as low

as 5.7 million feet in the smaller houses in North Wales and to 7.0 million feet in the larger houses in the same area. In the North of England the quantities are 6.3 and 9.0 million feet respectively.

To convert the lengths shown into average hours per day, it is necessary to assume that in general every house opens about the same time every day, and therefore that it is necessary to compute the length of film which is represented by one hour per day throughout the year. Ignoring Sundays at this stage, and excluding Christmas Day and Good Friday, there are 311 days per annum during which the cinema would be open. The quantity of film per annum for each

TABLE XVI.

Estimated Number of Hours open per Weekday.

District.	Seating Capacity up to 1,000.		Seating Capacity over 1,000.	
	Hours.	Minutes.	Hours.	Minutes.
1. London (Postal area) ...	9	2	9	9
2. Home Counties ...	7	31	9	9
3. Eastern Counties ...	5	36	9	18
4. West of England ...	5	57	8	55
5. Midlands ...	5	2	7	31
6. Yorkshire and District ...	5	15	6	32
7. Lancashire ...	5	24	6	2
8. North of England ...	4	28	6	24
9. North Wales ...	4	2	4	58
10. South Wales ...	4	56	7	40
11. Scotland ...	4	42	7	1
Great Britain ...	5	40	7	40

hour per day will, therefore, be $5,400 \times 311 = 1,680,000$ feet. But the average programme contains about 10 per cent. of "unregistered" film, and an allowance must also be made for the time (here assumed to be 5 per cent.) during which no film is run at all, being given over to either stage shows or intervals. The average quantity per annum of "registered" film run corresponding to each hour per day is, therefore, reduced to $\frac{51}{60}$ of $1,680,000 = 1,410,000$ feet.

With this as a factor it is now possible by applying it to the figures in the last table to state the average number of hours daily during which the cinemas in each district are open. In the case of London, a correction must be applied for Sunday opening, which correction can be ignored, for the present at any rate, in other areas. This correction amounts to the length of film required for a run of about $4\frac{1}{2}$ hours each Sunday of the year and is therefore equal to $52 \times 4.5 \times 5,400 = 1,260,000$ feet.

The result of all these calculations is contained in the foregoing table, which is derived from Table XV by dividing the film run per annum by the film run one hour per day per annum.

The range of variation in the hours during which cinemas are open to the public in different parts of the country appears to be considerable. As might have been expected, the larger cinemas, situated, as has been said, in towns and the more congested areas where earlier opening times or more frequent matinées prevail, are open on the average two hours longer each day than the smaller houses. In the London Postal area the difference is negligible, which accords with common experience. In the Eastern Counties the difference is most marked, amounting to nearly $3\frac{3}{4}$ hours per day. This is due to the fact that the cinemas in rural areas are very small, and matinées are usually limited to about once a week. On the other hand, the cinemas in the larger towns—like Norwich and Yarmouth—include comparatively few of the smaller houses and are usually open from about 1 p.m. or 2 p.m. each day. At the bottom of the list are the houses in Wales, where the average for small houses is between four and five hours per day, and for the larger houses between five and $7\frac{3}{4}$ hours per day. Although there may be certain errors in the actual results arising from the inadequacy of the samples upon which the calculations have been based, the broad outlines of the picture here represented accord with the general impression of direct observation.

One other conclusion may, with reasonable assurance, be drawn from the foregoing figures. In the smaller houses it may be assumed that the programme is played through twice daily; in the larger houses the average is thrice daily. The potential daily capacity (cp. Table VI) is therefore about $9\frac{1}{2}$ millions daily. But the actual "admissions" do not amount to an average of more than 3,100,000 daily throughout the year, from which the interesting and important deduction follows that day and night, winter and summer, the average number of persons in the cinemas of the country is not more than one-third of the seating capacity.

Cinemas in the London County Council Area.

A special interest undoubtedly attaches to the cinema situation in the area administered by the London County Council. As an economic unit the distinction has doubtful significance from the point of view of the film. There is so much agreement on administration policy between the London County Council and the Middlesex and Surrey County Councils, that any differences that might be sought for because the cinemas are in different areas can be ruled out at once. The policies as to censorship, Sunday opening, admission of children, employment conditions, building conditions and

safety precautions are practically identical, and for all practical purposes the Postal area is, probably, much more satisfactory for the purposes of the present inquiry. Nevertheless, there may be a special value to certain enquirers in setting out the distribution of cinemas in the boroughs included in the London County Council area, and for them the following table is provided (Table XVII) showing the number of cinemas in each borough and the seats grouped in two main classes—those with seats over 1,000 each and those with less.

TABLE XVII.

Cinemas and Seats in the London County Council Area, and in Relation to the Population.

Borough.	Popula- tion, 1933.	No. of Licensed Cinemas.			Seating.			Popltn. per Cinema.	Popltn. per Seat.
		1,000 seats and under.	Over 1,000 seats.	Total.	1,000 and under.	Over 1,000.	Total.		
	(thous.)				(thous.)	(thous.)	(thous.)	(thous.)	
Battersea ...	151.0	3	3	6	2.5	4.1	6.6	25.7	23
Bermondsey ...	107.3	6	3	9	4.5	5.2	9.7	11.9	11
Bethnal Green ...	104.2	6	1	7	4.1	1.1	5.2	14.9	20
Camberwell ...	243.7	9	4	13	6.8	8.7	15.6	18.7	16
Chelsea ...	58.9	2	1	3	1.4	3.0	4.4	19.6	13
City of London ...	10.2	2	—	2	1.0	—	1.0	5.1	10
Deptford ...	102.8	2	2	4	1.3	3.5	4.7	25.7	22
Finsbury ...	66.6	1	1	2	0.8	1.5	2.3	33.3	30
Fulham ...	148.2	4	2	6	3.2	2.6	5.8	24.7	26
Greenwich ...	97.8	4	—	4	2.5	—	2.5	24.5	39
Hackney ...	214.3	6	6	12	4.8	10.8	15.6	17.9	14
Hammersmith ...	131.4	3	10	13	2.2	17.4	19.6	10.1	7
Hampstead ...	90.4	1	4	5	0.6	7.0	7.5	18.1	12
Holborn ...	36.1	—	2	2	—	2.4	2.4	18.0	15
Islington ...	314.2	10	7	17	6.4	12.2	18.6	18.5	17
Kensington ...	181.1	5	3	8	2.3	5.5	7.7	22.7	23
Lambeth ...	289.0	11	6	17	6.7	11.8	18.4	17.0	16
Lewisham ...	221.1	8	8	16	5.9	15.3	21.1	13.8	10
Paddington ...	141.9	6	1	7	3.7	1.4	5.1	21.3	23
Poplar ...	149.3	6	2	8	3.9	2.5	6.5	18.7	23
St. Marylebone ...	94.1	4	4	8	2.5	7.5	10.0	11.8	9
St. Pancras ...	190.9	3	8	11	1.9	12.0	13.9	17.4	14
Shoreditch ...	93.6	5	2	7	3.0	3.1	6.2	13.4	15
Southwark ...	164.7	4	4	8	2.1	9.2	11.3	20.6	15
Stepney ...	219.1	11	4	15	6.7	9.1	15.8	14.6	14
Stoke Newington ...	51.1	1	2	3	0.8	2.9	3.7	17.0	14
Wandsworth ...	350.2	8	13	21	5.0	22.5	27.5	16.7	13
Westminster ...	126.3	13	14	27	6.2	27.2	33.4	4.7	4
Woolwich ...	146.2	7	4	11	4.5	5.4	9.9	13.3	15
		151	121	272	97.3	214.9	312.1		

Compared with the country as a whole the following differences are observable. First, the greater proportion of cinemas in London with seats not exceeding 1,000 each. The proportion was 55.5 per cent., against 52 per cent. for the entire country. But the smaller cinemas were not quite so small, and the larger cinemas appreciably larger than throughout the country, with the result that the average size was 1,150 compared with 910 for the whole of Great Britain.

The largest number is situated in Westminster, which covers the West End, and the smallest number in Finsbury, Stoke Newington, Holborn and Chelsea. A serious mistake would be made if the number of cinemas in these areas were in any way compared with the resident populations. London is a city of large daily movements of population, assisted by the extraordinarily large and efficient transport system of electric railways, buses, trams and taxis, with the result that distances which would effectively bar journeys to the cinemas elsewhere are freely undertaken by persons of every class living in London or the suburbs. Added to all this there is a large transient population, commercial and tourist, avid for some kind of entertainment during the afternoons and evenings and who contribute largely to the cinema attendances in such districts as Westminster. It is this, of course, which explains the fact that in Westminster there is a cinema for every 4,700 of the resident population and a cinema seat for every four persons living there. Compare this with the figures 25,700 and 23 respectively for such a district as Battersea.

Film Supply and Distribution.

The sources from which the enormous demand of the cinemas is continuously satisfied, and the methods by which this supply is regularly and continuously distributed to the cinemas and, thereby, to the public, call for answers to a large diversity of questions, and an investigation of conditions in various countries. It is obvious to even the least observant and the most casual cinemagoer, that the large majority of the films in the programmes provided is of foreign origin. Attractive though the problem might be, this is not the place—at least not the occasion—for a discussion of the social or political effects of providing the large mass of the people with foreign-made entertainment. In order that my abstention from this discussion be not misunderstood, I hasten to state that on balance and after noting everything that can be said for and against the foreign film, there is in my opinion very considerable national advantage from the admission of foreign films to our screens. All who take a long view of the educational influence of the film, whatever its origin, must be prepared to look on it with the same approval as they would extend to everything else that adds to knowledge and experience. This admission does not go so far as to deny that good grounds might, nevertheless, exist against the exclusive or excessive dependence on a supply from any single geographical area, and especially if it involved the proscription of films made in our own country.

Seeing that the main purpose of the present enquiry is to obtain a statistical measure of some of the problems and phenomena of

the film industry, it would be natural at this stage to refer to the Trade Returns and to select, tabulate, and analyse the information they contain and formulate conclusions therefrom on the trade in cinematograph films. An expedition to those portentous tomes would, however, prove miserably futile. I can recall no other article of foreign trade in which the Trade Returns figures are so inaccurate, misleading, meaningless and valueless as those which are to be found under the various "cinematograph film" headings in the Annual Statement of Trade. The difficulties are not due to any official failure, but are really inherent in the character of the trade itself.

Those who resort to these Returns for information would naturally expect reasonably accurate figures of quantities and or values of films, under distinct and comprehensive headings, and showing the countries of origin or destination. So large a part of the import trade (and to some extent this now applies also to the export trade) is made up of goods consigned to agents in this country for what is in effect realization at the best prices they can make, that it is not surprising that valuation at the port is unsatisfactory and almost impossible. Of two films produced in Hollywood costing, perhaps, £100,000 each, one may gross £60,000 to the agent in this country, and the other not more than £10,000. After payment of all costs and expenses in this country, the former might leave a surplus of £40,000 and the latter nothing at all for remittance to the producers. Not even the most expert trade valuers could make a worth-while estimate of the value of any film on its first arrival at a British port. It follows, therefore, that accurate declaration of value on importation is in such cases impossible. A further complication exists in the fact that the normal procedure in the film trade is, first, to import a positive print of every subject. This is followed at a later date—from three to six months later—by the negative, from which the number of positive prints or copies required to satisfy all the contracts made with the exhibitors are made in special film-printing laboratories in this country. For various reasons—sometimes because the original negative cannot be spared by the American distributors; sometimes because the owners are unwilling to take the risk of subjecting a valuable property to the physical hazards of a Transatlantic crossing; sometimes because a financial house in America has a lien on the negative and its earning power in that country and is unwilling, therefore, to forgo the physical possession of a valuable security; and sometimes because it is desired to reduce the liability to import duties—the negative is withheld and is replaced by either a sufficient number of foreign-made positive prints or by a specially prepared "lavender" print

(so called because of the tint of the film material on which the print is made) from which a "dupe" negative can be derived. The difference in the duties between an original "talkie" negative and positive print ("lavender" or ordinary) is very great. For a subject of 6,000 ft. length, the amounts are £250 and £25 respectively. Where fewer than ten copies are required it might be more profitable to import prints than the negative.

From the foregoing account the difficulties of valuation at the ports are obvious. Even if a total value for any subject could be estimated, complications would arise in deciding whether the valuation should be declared when the print first arrived, or when the negative or "lavender" prints or consignment of prints to dispense with the negative was reported. All these questionings make the importance of intelligent returns of quantity so much more urgent. A new classification of cinematograph films is long overdue, and I hope attention will be given to this in the proper Department at the earliest moment. As a basis for consideration I suggest the following :—

Cinematograph Films—Standard width of 35 mm.

A. NEGATIVES :

- (a) Picture only.
- (b) Sound Track only.
- (c) Picture and Sound Track combined (including "dupe" negative).

B. POSITIVE PRINTS :

- (a) "Lavender," intended for "dupe" negatives.
- (b) Ordinary Black-and-White or monochrome.
- (c) Colour films (*i.e.* containing two or more colours or intended for reproduction in colour).

It is, further, desirable that the returns under each of the foregoing classes be further subdivided into subjects of less or more than 3,000 ft. respectively.

Even though the Trade Returns were as fertile of information as, in fact, they are barren, they could only tell us about the external trade in films—imports and exports—and nothing at all about the supply now derived from home sources. It is no longer true, as it was a few years ago, that the British supplies are negligible, and account must now be taken of the British as well the foreign supply in any study of the sources from which the films required in British cinemas are derived. Luckily—from a statistical point of view—the returns made in recent years to the Board of Trade by exhibitors, renters (*i.e.* distributors) and producers (*i.e.* manufacturers) respec-

tively, provide exceptionally valuable material on many aspects of the Trade, some of which belong to the enquiry with which the present paper is concerned. At a later stage this material is extensively employed in an examination of the operations of the Films Act. At this point we are concerned only with the present supplies.

The Films Act is concerned only with "registered" films and the returns can apply, therefore, only to registrable films. This term applies to, practically, all films except news reels, interest, educational, instructional, scientific, industrial and advertising films. The deficiency is, however, made good to some extent by the returns of the British Board of Films Censors, without whose certificate no film (except news reels and, perhaps, advertising films) can be shown in a British cinema. The following table summarizes the returns in the most recent year from these two sources.

TABLE XVIII.

Comparison of "Registered" Films and those Passed by the Censors.

	Registered Year ending 30th March, 1935.			Passed by Censors Year ending 31st December, 1934.
	British.	Foreign.	Total.	
Feature Films No. ...	190	477	667	690
Short " No. ...	123*	697	820	571
Interest Films (including science, industrial, natural history and cartoons) No.	—	—	—	601
Total length of all Films (‘000 ft.) ...	1,314	4,007	5,300	5,830

* This figure may include certain subjects (about 56 in number) which in 1934 were registrable for Exhibitors' Quota, but were not allowed for Renters' Quota—*vide* footnote † Table XIX.

The number of "feature" films (*i.e.* in both cases meaning dramas and comedies more than 3,000 ft. long) was 667 registered and 690 passed by the Censors. This is a close enough agreement having regard to the difference in the year-ending. The registrations indicate that the 667 "feature" subjects consisted of 190 "British" and 477 "foreign." It should be remembered that the term "British" as applied to registrations has a meaning sharply defined by the Act. It may include films satisfying certain statutory conditions made in any part of the British Empire. It may also exclude certain films made in Great Britain which do *not* satisfy those conditions. Despite these restrictions it is nevertheless true that, with very few exceptions, all the "British" films were made in Great Britain and all the films made in Great Britain were "British." It

follows, therefore, that 28.5 per cent. of the number of feature subjects and more than 27.5 per cent. of the length, were British. The mistake must not be made of assuming that these figures will also represent the proportions of films shown to the public. This would be true only if the frequency of exhibition of films in each of these categories was the same in both cases.

The comparison between "short" films registered with those "passed by the Censors" involves a correction in the latter figures. With the exception of "cartoons," which are registrable and should therefore be transferred to the registered "short" films, all the films included under the head of "Interest Films, etc." have no place in the returns of registered "short" films. So far as can be ascertained from a direct enquiry from all the distributing firms in the Trade, cartoon films last year number 160 subjects. It appears, therefore, that according to the Censors' returns the number of registered shorts ought to have been about 730, whereas, in fact, it amounted to 820, and of unregistered shorts about 440. There is here a discrepancy for which no explanation is at present forthcoming.

The Cinematograph Films Act (1927).

In 1927 there was placed on the Statute Book a measure known as "The Cinematograph Films Act (1927)," which came into operation on January 1st, 1928. This measure—popularly referred to as "The Quota Act"—had for its principal objects the imposition upon the exhibitor of an obligation to screen and on the renter (*i.e.* distributor) to acquire in each year an increasing fraction of British films in relation to the total film respectively screened or rented. These fractions are known as "exhibitors' quota" and "renters' quota," and the amounts varied from 5 to 20 per cent. in the former case and from $7\frac{1}{2}$ to 20 per cent. in the latter case. By the Act the obligation as to quota applies only to films which have been "registered," and it expresses also that all films must be registered by the renter before he can entertain and conclude a valid contract with an exhibitor for the showing of the film in a licensed cinema. All cinemas open to the public and making a charge for admission must be licensed, but films belonging to certain categories were excluded from the operation of the Act, and these films are not registrable. These non-regi-trable films consist, as previously stated, of news reels, scenic, educational, scientific, industrial and advertising films. The administration of this Act brought into existence a mass of statistical material which throws a great deal of light on many aspects of the film industry. The examination of some of this material is here undertaken for the first time.

My first table in this series shows the number of British and

foreign films—long and short*—registered in each of the years since the Cinematograph Films Act came into force.

Though included in Table XIX for completeness, the figures in the last three columns headed "All Films" are of comparatively little significance. They convey about as much intelligent information as would be obtained by adding carcasses of beef and mutton together and calling them "total carcasses." There is, however, one piece of information of interest which they do contain, for they show that the number of "registered" films (representing, therefore, all films except news reels, educational, scientific, "interest," industrial and advertising films, none of which are generally "registrable") amount to over 1,400 subjects a year. The amount of circulation which each of them secures in the cinema

TABLE XIX.
Number of Films Registered (for Renters' Quota).†

Period (years ending March 31)	Long.			Short.			All Films.		
	British.	Foreign.	Total.	British.	Foreign.	Total.	British.	Foreign.	Total.
1929	128	350	678	150	663	813	278	1,213	1,491
1930	96	306	602	180	885	1,065	276	1,391	1,667
1931	122	556	678	53	976	1,029	175	1,532	1,707
1932	153	464	617	44	917	961	197	1,381	1,578
1933	159	481	640	41	741	782	200	1,222	1,422
1934	190	484	674	48	647	695	238	1,131	1,369
1935	189	477	666	67	697	764	256	1,174	1,430

† A certain number of films were registered for Exhibitors' Quota which were not entitled to be registered for Renters' Quota. These have been excluded throughout this table.

varies between very wide limits, some of them securing perhaps not more than 50 to 100 "bookings" or engagements, others rising to as many as 2,000. It would be indeed interesting if a classification could be made of the subjects according to their respective circulations, but this information is one of the most closely guarded secrets of the Trade, and any attempt to interrogate the distributing firms on the subject would meet with rebuff. A little light is thrown on this question later in this paper. Here, however, we are concerned to note that the consumption of story material represented by the figures is enormous. According to our tastes, we may express admiration or contempt for some of the story-material finding its way into the films. What cannot be denied, however, is that the tax on the creative and imaginative powers of those responsible for providing and arranging all this enormous mass of material is tremendous, and on the whole deserves our respectful tribute.

* "Long" films are those exceeding 3,000 ft. in length: "short" films are those not exceeding this length.

By far the most important series of figures in Table XIX are those contained in the three columns under the heading of "long." These subjects, practically every one of which is more than 5,000 ft. in length, provide the staple of every programme. It is upon these that the exhibitor rests his expectation of attracting the public into his theatre. He chooses them with all the care that circumstances permit, attracted sometimes by the star, occasionally by the story, at other times by the splendour and magnificence of their spectacular scenes. He frequently pays less or even no attention to the remaining items in his programme, which he regards as merely so much "padding" or "fill-ups" to enable him to give his patrons a show running to not less than two hours and sometimes up to more than three hours. It is interesting to note, *en passant*, that not long ago there were signs among certain exhibitors of a desire to meet competition for patronage by showing programmes running to nearly four hours. This practice was, however, checked by the action of the Kinematograph Renters' Society, who threatened to refuse delivery of films to, or to enter into contracts with, any exhibitor who showed a programme exceeding $3\frac{1}{4}$ hours in duration.

One very interesting conclusion follows from the above figures and deserves mention. In the year 1934-5 the cinemas were generally open (excluding Sundays, Christmas Day and Good Friday) on 311 days. The number of "long" subjects in circulation in any year may be taken as approximately the number registered in the year ending six months earlier. For the year ending December 31st, 1934, therefore, the films in circulation would be the same as the films registered by renters in the year ending June 1934. This number, on the assumption of uniform rate of registration during the year, would therefore be

$$\frac{1}{4} \text{ of } 674 \text{ plus } \frac{3}{4} \text{ of } 666 = \text{or } 668.$$

If every programme contained only one "long" subject, it is evident that in the cinemas included in our present survey, each such subject would have been shown an average of, approximately,

$$\frac{4305 \times 311}{668} = 2,004 \text{ days.}$$

The normal period of showing in cinemas throughout Great Britain is three days, though a considerable proportion of them change programmes only once a week, and a number of others make changes every two days. Approximately, however, it is probably true that, on the assumption that twice-weekly changes are the general practice, each film is on the average shown in not less than 668 cinemas in Great Britain. In so far as it is the case that many cinemas habitually include two "long" subjects in every programme, the

average number of theatres showing any particular subject will be correspondingly increased.

One other interesting conclusion to be drawn from the same series of figures is the growing proportion of British, and decline in foreign, subjects in relation to the total supply. Comparing the first three years with the last three years, the average number of British subjects rose from 115 to 179, being an average increase of 64 subjects or 56 per cent. In the same period there was a decline of foreign subjects from 537 to 487, being an average drop of 50 subjects or about 9½ per cent.

The next table repeats the information in the previous one, substituting length of films for the number of subjects.

TABLE XX.

Length of Films Registered (for Renters' Quota) (in thousand feet).

Period (years ending March 31).	Long.			Short.			All Films.		
	British.	Foreign.	Total.	British.	Foreign.	Total.	British.	Foreign.	Total.
1929	904	3,400	4,304	170	922	1,092	1,074	4,322	5,396
1930	624	3,331	3,955	150	1,204	1,354	774	4,535	5,309
1931	789	3,649	4,438	60	1,160	1,220	849	4,809	5,658
1932	928	2,962	3,890	59	1,071	1,130	987	4,033	5,020
1933	961	3,057	4,018	47	893	940	1,008	3,950	4,958
1934	1,180	3,115	4,295	60	769	829	1,240	3,884	5,124
1935	1,183	3,116	4,299	68	891	959	1,251	4,007	5,258

Following the previous analogy, the figures in Table XX contain at least the same kind of information as would be derived by adding the *tonnage* of beef and mutton instead of the *number* of carcasses. The reduction of subjects to actual lengths gives a somewhat clearer view of the quantity of film required each year to supply and to satisfy the gargantuan appetites of this country's cinemas. But care in their use is necessary. Great differences in intrinsic cost and value—quantities not always the same or even related—exist. One length of 1,000 ft. may be copied 100 times and pass through the machines of the cinemas an aggregate of 6,000 days and from two to five times each day. Another length of 1,000 ft. may be called for on less than 500 days. The uncertainty is implicit in the fact that the figures in the table refer to "negatives," and these provide the positive copies varying in number between, possibly, less than 10 to as many as 150 or even 200 copies in certain special cases.

Bearing in mind, therefore, that these figures refer only to "negative" lengths, certain interesting facts and conclusions emerge from a closer examination of the table. It is seen first that

approximately 1,000 miles of "negative" are required each year, divided between "shorts" and "longs" in the approximate proportion of 2:9. This proportion is now appreciably less than in the years 1928-9 to 1930-1, when the proportion was as high as 2:7. The reduction in the supply of short subjects is attributable principally to a falling-off of British production in this field. Compared with the total foreign production registered here, the "short" films have fallen from 24 to 21 per cent. between the first three years against the last three years. The British supply in the same period fell from 14.1 to 5.0 per cent. of the entire registered British output.

The fall in the number of short subjects now being produced, below the level of a few years ago, is significant and regrettable, because it implies diminishing attention throughout the world's production centres, to those kinds of subjects which introduce the principal element of variety in the average programme. In my opinion, based on my personal observation, there has not been any intrinsic improvement in the entertainment quality of the short subjects which by calling for an increased number of copies might have compensated in "positive" lengths for reductions in "negative" lengths. It is probably accurate to say that "shorts" now appear less frequently in the average programmes than a few years ago.

Clearer evidence of the decline in the quantity of foreign, and the increase of British, "long" negatives is further provided by Table XX. The average length of foreign negative of this class fell by about 200,000 ft. per annum in the three years ending March 31st, 1935, from the average of the three years ending March 31st, 1931. The corresponding figures of British film show an increase of nearly 270,000 feet. It is difficult, perhaps impossible, to prove that the increased British supply is the direct, or even remote, consequence of the reduced foreign (or American) supply. The period under discussion follows hard on the great 1929 Wall Street "crash," one of whose repercussions was felt throughout the film industry, both in the studio or producing, and the cinema or exhibiting organizations. For example, in 1930 and 1931 cinema attendances in the United States were estimated to have fallen by more than 40 per cent. This alone would account for a reduction in number and in average costliness (and costliness cannot be altogether dissociated from attractiveness) of the pictures made in Hollywood and would be of advantage to the British film industry, which, after the technical revolution caused by the introduction of "talkies" in 1929, was making strenuous efforts to establish itself. Undoubtedly the conjuncture of the crash and the audible American twang did more to supply a momentum to the struggling British film production

industry than even the Quota Act. This admission does not, however, deprive the Act of merit, because it had succeeded in the two years of its existence in laying firm foundations for an industry which was capable of responding to the demand for product caused by the shortage of the American film supply.

The quota liability is imposed on both "shorts" and "longs," but in such a way that if there should be any deficiency in the supply of British "shorts," this deficiency can be made good by a corresponding excess in the supply of British "longs." The reverse operation is not permitted, however, and any surplus in British "shorts" does not operate to reduce the liability on "longs."

The following table (Table XXI) sets out for comparison the

TABLE XXI.

Comparison of British Film produced with Minimum Quota Requirement.

Year ending March 31.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
	Quota. Per cent.	Foreign Shorts registered. '000 ft.	British Shorts required for Quota. '000 ft.	British Shorts registered. '000 ft.	Deficiency in '000 ft.	Foreign Longs registered. '000 ft.	British Longs required for Quota. '000 ft.	Min. length of Brit. Longs required for Quota, (Col. 7 + Col. 5).	Actual length of British Longs registered. '000 ft.	Excess of British Longs produced. Length.	Per cent.
1929	7½	922	75	170	—	3,400	276	276	909	633	230
1930	10	1,204	134	150	—	3,331	370	370	624	254	70
1931	10	1,160	129	60	69	3,649	405	474	803	329	69
1932	12½	1,071	153	59	94	3,962	566	660	931	271	41
1933	15	893	158	47	111	3,057	540	651	974	323	50
1934	17½	769	161	60	101	3,115	661	762	1,203	441	58
1935	17½	891	189	68	121	3,116	661	782	1,186	404	52

length of British film produced since 1928 with the corresponding minimum liability on the foreign film registered each year. The method of the calculation is indicated by the following example. In 1931-2 the renters' quota was 12½ per cent., or one-seventh of the foreign film registered. The liability arising from 1,071,000 ft. of foreign "shorts" was, therefore, 153,000 ft. British "shorts." The actual quantity of British "shorts" registered was only 59,000 ft., being a deficiency of 94,000 ft. to be carried forward to the "long" film. In that year the foreign "long" films registered were 3,962,000 ft., representing a quota liability of 566,000 ft., which with the deficiency on "shorts" brought forward amounted to 660,000 ft. The actual quantity of British "long" films registered was 931,000 ft., which indicates an excess of 271,000 ft. or

41 per cent. on the minimum quantity which would have satisfied the total quota liability of all renters in that year.

Glancing down the last four columns of Table XXI, the progressive growth in the output of the British film production industry, absolutely and in relation to the minimum statutory liability, is clearly indicated. The minimum demand rose from 276,000 ft. in 1928-9 (when the quota was $7\frac{1}{2}$ per cent.) to 782,000 ft. in 1934-5 (when the quota was $17\frac{1}{2}$ per cent.). The production actually registered was 909,000 ft. in the first year (an abnormal amount due to the postponed registration of a considerable number of British films in the first year) and 624,000 ft. in the second year (by which time normal conditions were ruling) to 1,186,000 ft. in the last year. The output in the last year was, therefore, 52 per cent. in excess of the statutory requirements. I have elsewhere referred to this fact, and I do not hesitate to repeat it here, as a conclusive demonstration that the Act has achieved its purpose of establishing an industry which might never have come into existence without the protective aid of this legislation.

In one important respect the figures in the previous table may be misleading. They assume a collective liability and a collective response to that liability. The industry consists, however, of a number of independent companies, each of whom must comply separately with its quota obligation.* What has been the experience of these separate companies under the Act? The result of this examination is set out in the following table (Table XXII), which has been compiled from the registrations of films published in the *Board of Trade Journal* each week since the Act came into operation in 1928. The companies named in the table include all who have registered not fewer than six "feature" (*i.e.* long) films in any year since the Act came into force. A distinction is made between British and foreign firms, the latter designation being well understood to mean companies which, though registered in Great Britain, are wholly owned and controlled by foreign companies. The analysis actually extends to 4,989,000 ft. or 93 per cent. of the total of 5,321,000 ft. registered by all the companies licensed to trade as renters.

Even a casual look at the figures in the last three columns of Table XXII indicates that none of the excess supply of British films previously noted was attributable to the foreign companies. Of 186 British feature films here included, 75 were registered by the British companies and 111 by the foreign companies. On the other

* An exception to this principle is permitted by the Act in the case of renters registering not more than six long films in any year. These renters could "club" their quota liability, but the use made of this privilege has been practically negligible.

TABLE XXII.
*Number and Length of Registered Films in Year ending March 30, 1934.**

Renter.	Number of Subjects.				Length (in 1,000 ft.).							
	Long.		Shorts.		Long.		Shorts.		Total.		Total.	
	British.	Foreign.	British.	Foreign.	British.	Foreign.	British.	Foreign.	British.	Foreign.	British.	Foreign.
<i>British Companies.</i>												
Associated British Film Distributors	0	8	1	—	1	64	49	113	3	—	67	49
Associated Producing and Distributing Co.	2	3	—	1	1	16	15	31	2	2	16	17
British Lion Film Corporation	6	7	—	6	6	39	46	85	6	6	39	52
Butcher's Film Service	4	13	—	—	—	26	74	100	—	—	26	74
Equity British Films	2	7	1	8	9	9	40	49	—	7	11	47
Gaumont-British Co.	28	25	2	36	38	202	168	360	4	48	206	206
Pathé Pictures	6	27	—	—	—	33	162	185	—	—	33	162
Producers' Distributing Co. ...	2	16	—	—	—	12	99	111	—	—	12	99
Wardour Films	16	7	1	37	38	108	46	154	1	39	109	85
<i>Foreign Companies.</i>												
Columbia Pictures Corporation	5	23	4	31	35	33	143	176	4	32	37	175
First National Film Distributors	9	15	—	38	38	46	153	199	—	59	46	212
Fox Films	13	43	—	31	31	66	289	355	—	59	46	212
Metro-Goldwyn-Mayer	15	49	12	65	77	86	372	458	12	19	66	308
Paramount Film Service	18	64	—	101	101	108	407	515	86	98	108	510
Radio Pictures	16	49	—	83	83	89	306	395	103	103	108	510
United Artists	12	36	—	47	47	90	326	326	110	110	89	416
Universal Pictures	14	46	6	92	98	84	282	366	42	42	90	278
Warner Bros.	9	26	—	53	53	50	169	219	6	144	90	426
Total	186	464	27	629	656	1,161	3,036	4,197	32	790	1,193	3,796
									792	63		4,989

* There is a slight discrepancy between these figures and those in Tables XIX-XX owing to the inclusion here of British films registered for Exhibitors' Quota but not for Renters' Quota. The individual corrections are, however, not important.

hand, out of a total of 464 foreign films registered, only 113 were distributed by the British companies and 351 by the foreign companies. In the one case British films represented 40 per cent. of the number put out by the British firms and 24 per cent. of those put out by the foreign companies. What is not obvious at this stage, but it is a fact nevertheless, is that the foreign films handled by the foreign companies are of very different calibre from the foreign films handled by the British companies. The former comprise nearly all the productions of the major Hollywood companies, employing the most

TABLE XXIII.

Comparison of British Films Registered by the Principal Companies in 1933-4 with their Minimum Quota Requirements.

	Quota Liability.	Length Registered.
	(thousand feet)	(thousand feet)
<i>British Companies.</i>		
Associated British Film Distributors ...	10	67
Associated Producing and Distributing Co. ...	3½	16
British Lion Film Corporation ...	11	39
Butcher's Film Service ...	16	26
Equity British Films ...	10	11
Gaumont-British Distributors ...	44	206
Pathé Pictures ...	32	33
Producers' Distributing Co. ...	22	12 *
Warner Bros. ...	18	109
<i>Foreign Companies.</i>		
Columbia Pictures ...	37	37
First National Film Distributors ...	45	46
Fox Films ...	65	66
Metro-Goldwyn Mayer ...	98	98
Paramount Film Service ...	108	108
Radio Pictures ...	88	89
United Artists ...	59	90
Warner Bros. ...	49	50

* The deficiency shown in this case was met by a special and permitted arrangement made with Associated British Film Distributors, Ltd.

highly paid stars, directors, and authors, upon which a lavishness of expenditure has been applied which the mere cinemagoer accepts without question. On the other hand, the British companies realize that successful trading would become to them impossible if they had to rely exclusively on the foreign films, produced by independent companies in Hollywood who have not got the same kind of direct representation for the sale of their films here as the major companies. These British companies have, therefore, encouraged the British producing companies to make films which possessed intrinsic merit and attraction to the public, and which could justify, solely by

commercial standards, the outlay of the comparatively large sums involved. It is true, and the film trade readily recognize it, that British film production might never have been, but for the determination, courage and enterprise of the British renting companies.

In Table XXIII there is shown more clearly how closely the various companies have complied with the obligations under the Act.

The very striking fact disclosed by this table is the closeness with which all the foreign companies (with one exception) succeeded in registering exactly the quantity of British film which accorded with their quota liability. On the other hand, nearly every British company produced its British films in quantity far in excess of their statutory liability, and probably entirely without any regard to that liability. The British firms were, in fact, concerned with the development of the new home industry; the foreign firms had no such interest and were concerned only with such a technical compliance with the Act as to permit the exploitation of their own imported films.

If it were possible there would be exceptional interest in an examination of the relative values of the British and foreign pictures respectively offered by the various companies. There is obvious difficulty in agreeing on a standard of measurement for "relative values." It might be either "cost" or "earnings," neither of which can be known. It might be some standard of artistic merit which is, however, too intangible for definition or measurement. We are entitled to assume, however, that whatever the standard of measurement, the relative values of a series of pictures would be represented by a progressive series of figures, rising or falling with the value. In the same way we might arrange a group of twenty individuals according to their respective Income Tax assessments, knowing no more than that proceeding along the line each individual is assessed at a higher figure than his left-hand neighbour. Or we might arrange a group of persons occupying different chairs in a University according to an assumed order of intelligence, starting with a professor of poetry at one end of the scale and a professor of statistics at the other end. You note I do not indicate which are the upper and lower ends of the scale! Having arranged the series in such an ascending or descending scale it is possible to subject the series to some statistical treatment, converting the positions in the scale into certain relative values if we can attach approximate values to a few of the positions. If out of a group of twenty persons we know that the first has an income of £300 a year, the tenth of £700 a year, and the twentieth of £5,000 a year, we can determine a most probable curve of incomes for each of the other individuals in the group.

A method similar to the one last mentioned has been employed

to answer the same kind of question in connection with the films handled by the various companies. Advantage has been taken of the "markings" published by the Cinematograph Exhibitors Association each week, by means of which exhibitors are advised of the relative merits of the pictures which have been trade-shown in the previous week. How much a picture marked 8 is better than one marked 7 is probably unknowable and certainly unknown, but it is intended to imply, and it is probably true, that it is a better one, that in general it will have cost more to produce, and certainly that, in the opinion of the viewers of the film, it should earn for the exhibitor a larger sum. These markings range up to 10 by steps of $\frac{1}{4}$, and experts would probably agree that up to about 7 or 8 the progression is extremely slow, and thereafter until a 10 mark is reached the resumed progression of values is very rapid. If, for example, a film marked 10 is capable of earning £100,000 for the distributor, one marked 8 might earn no more than £30,000, and one marked 7 not more than £5,000, and so on. The object of my present quest was to determine the "weights" for each of the film markings, and I therefore decided on a formula of the type

$$z = \log^{-1} (ax + b) - c$$

where $a = .2$, $b = .05$, $c = 9$.

This formula was then applied to 611 subjects, trade-shown during 1934 and, marked, by the Cinematograph Exhibitors, Association with the following results.

TABLE XXIV.

Estimated (Weighted) Average Marking of Films in 1934.

Registered by	British Films.	Foreign Films.
British Companies	8	7 $\frac{1}{4}$
Foreign Companies	7	8

The difference between a mark of 7 and 8 represents a very considerable difference of value. What the above really indicates is the fact that the business is carried on and controlled by two distinct groups of traders. The first handles good British films and poor foreign ones; with the second the order is completely reversed. This result from analysis is, of course, completely confirmed by general experience in the trade. On the whole the inferior British films are handled by the foreign companies, and the inferior foreign films are being offered by the British companies.

The Exhibitors' Quota.

A considerable amount of statistical material directly relating to exhibitors is contained in earlier parts of this paper. The very significant question which arises naturally at this stage is concerned with the experience of exhibitors in relation to the quota. As regards the totality of exhibitors throughout the country, a summary of exceptional interest is provided by some figures published by the Board of Trade during each of the past three years. These figures are collated from the returns which must be made by every exhibitor in respect of every cinema he controls, showing the aggregate length

TABLE XXV.

Footage of Registered Films Exhibited in Great Britain (in thousand millions of feet).

Year ending Sept. 30.	Exhibs.' Statutory Quota. Per cent.	British.			Foreign.			Total.		
		Short.	Long.	Total.	Short.	Long.	Total.	Short.	Long.	Total.
1932	10	0.24	6.89	7.13	4.37	21.49	25.86	4.61	28.38	32.98
1933	12½	0.20	7.90	8.10	3.80	22.20	26.00	4.00	30.10	34.10
1934	15	0.24	9.22	9.46	3.59	23.21	26.80	3.83	32.43	36.26

TABLE XXVI.

Annual Percentages of British to Total Film shown by Exhibitors during the past Three Years, and Comparison with Statutory Quota.

Year ending Sept. 30.	Exhibitors' Statutory Quota.	Actual Quota of Films Screened.		
		All Films.	Long Films.	Short Films.
1932	10	21.60	24.27	5.13
1933	12½	23.70	26.20	5.26
1934	15	26.10	28.4	6.67

of British and foreign registered film screened in each year. (It should be noted in this summation that if a 1000-ft. film is screened three times in any day, the footage shown in the returns will be 3,000 ft. for that day.) The results are given in the following illuminating tables (Tables XXV and XXVI).

In each year the exhibitor has shown from 70 to 120 per cent. more British film than, by law, he was obliged; and so far as the principal item—"long" films—is concerned, the excess has been from 90 to nearly 150 per cent. Only in the category of "short" films has there been a consistent inability to show sufficient British "short" films to satisfy the quota liability for "short" films independently. All

parties concerned seemed to have agreed readily to compensate for the deficiency by screening additional British "long" subjects. There is food for serious reflection in the fact that exhibitors are now screening fewer "short" films than two years ago, the average decline during the last two years being at the rate of 390 million feet per year—entirely foreign. No doubt this is very largely a reflex of the changing conditions in the trade of recent years, leading exhibitors in the direction of increasing the programme offered to the public by showing two long films in their programme instead of one only. There is then no time left in the programme for the inclusion of even the limited number of "shorts" that formerly appeared.

These tables seem to contradict the assertion, very prevalent among exhibitors, that the "quota" has proved onerous and should be drastically amended either by abolishing the quota altogether or by cutting it in half. Doubtless there are certain cases up and down the country, principally at certain positions in a number of the large towns, where the supply of good British films has not sufficed to enable all the exhibitors in the locality to have a good alternative choice of high-grade product. Rather than show a good film *after* another theatre in the district, many of such exhibitors prefer to show an inferior British film, though knowing it is without the merit which would entertain their usual patrons. I do not feel this is the place for debating the question of policy implied in this established trade practice, but it must be abundantly clear that such grievance as exists would clearly tend to disappear with every increase in the number of good films and every improvement in the quality of the bad films.

An exceptionally striking result of great importance is derived from a comparison of some of the figures in Table XX with those contained in Table XXV. In the earlier table the actual length of both British and foreign registered films acquired by the renters (*i.e.* distributors) in each year is shown. This, as was explained, is the length of the subjects counting each subject only once. The figures in the second table are the footage screened, which, subject to adjustment of the periods, will be equal to the length of all the subjects multiplied by the average number of times these subjects have been screened. Remembering that it is very approximately true that the films actually exhibited to the public in any year can be assumed to be the same subjects as were registered about six months earlier, the suggested comparison can be directly applied. In the year ending March 31st, 1934, there was registered 3,884,000 ft. of foreign and 1,275,000 ft. of British film of all kinds. Turning next to the exhibitors, returns for the year ending September 30th, 1934, these gave 26,800 million feet of foreign film, and 9,460 million

feet of British film. Thus the average screenings of the foreign film must have numbered 6,900 and of the British film 7,630 times. Assuming an average run of three days to each booking, and the average number of screenings as being three times daily, these figures indicate that the foreign films were booked to an average of 767 cinemas and the British films to an average of 848 cinemas. These figures appear to me to demonstrate quite conclusively the superior general average of attractiveness of the British film to British exhibitors and, presumably, to British audiences.

The following is a summary of the principal conclusions, indicated in this paper, of the survey of the industry in Great Britain in 1934.

I. Admissions and Payments.

1. The total number of paid admissions in 1934 to cinemas in Great Britain was 963 millions.
2. The amount paid by the public for these admissions was £41,120,000.
3. Of this sum about £6,800,000 was deducted on account of the Entertainment Duty then in force.
4. The average price per seat was 10·25*d.* (including duty).
5. Exclusive of Entertainment Duty, about 43 per cent. of all the cinema admissions were at prices not exceeding 6*d.* each, and about another 37 per cent. paid not more than 10*d.* Otherwise stated, nearly 80 per cent. of all the admissions were at prices not exceeding 1*s.* (including duty).
6. The average weekly cinema attendances throughout the year is about 18½ millions.
7. Seasonal fluctuations of cinema attendances throughout the year are very considerable. In 1934 the weekly average fell to about 13·8 millions in June and 14·5 millions in July, and rose to 20·9 millions in September and October and 21·8 millions in January.
8. There is reason to believe that cinema attendances in any area are the resultant of two principal conditions: first, the weather; and second, the attractiveness of the principal picture.

II. Cinemas and Seats (including hours open daily).

1. The number of regular cinemas (*i.e.* open not less than six days a week) in Great Britain at the end of 1934 was 4,305 and the number of seats in them was over 3,872,000.
2. More than 70 per cent. of the cinemas had fewer than 1,000 seats each: and more than 52 per cent. of the total cinema seats were to be found in these houses.

3. The average size of cinemas varies widely in different districts. In the London area it averages about 1,150 seats, in the Home Counties about 850, in the Lancashire area about 970, in Wales about 750, in the West of England about 680.
4. In relation to the population the numbers of cinemas and seats vary between wide limits. In the London area there is a cinema for every 15,900 of the total population (1931); in South Wales the corresponding figure is 8,000. The corresponding figures for populations aged 15 and over are 12,400 and 5,800.
5. Measured by the number of seats rather than number of houses, there were, in the London area, one seat for every 14 of the total population, in the Lancashire area one to 9, in the Eastern Counties one to 19, in South Wales one to 10, and so on. Eliminating the population under 15—as comparatively infrequent cinemagoers—the number of persons per seat were, in London, 10·9; in the Eastern Counties, 14; in the Midlands, 9·6; in Yorkshire, 8·0; in Lancashire, 7·0; and in South Wales, 7·6.
6. There is definite correlation between the size of cinemas and the density of population. It is found that as the population per square mile increases, the proportion of small houses diminishes and of large houses increases, the correlation coefficient changing from a negative value of $-0\cdot413$ to a positive value of $0\cdot404$.
7. Since 1932 the new cinemas built in Great Britain amount to 302, containing 351,500 seats, an average of 1,160 seats per house; or more than 25 per cent. larger than the average throughout the country for all existing cinemas.
8. By comparison with existing seat accommodation, the largest amount of new construction has taken place in the London area, the increase being about one-sixth. In the Midlands the increase is about one-twelfth, in Yorkshire about one-twentieth, in Lancashire about one-twenty-third, and in South Wales about one-sixtieth.
9. It is estimated that Sunday opening is now permitted in 874 cinemas in England and Wales, and that these contain from 850,000 to 900,000 seats.
10. The average daily time during which cinemas are open varies between wide limits throughout the country. In the smaller cinemas (up to 1,000 seats) the average is about nine hours in the London area, four hours in North Wales, and just under five hours in South Wales. In the larger houses (over 1,000 seats) the daily average is about two hours longer.

11. It is estimated that throughout the year the cinemas are on the average only one-third full.
12. In the London County Council area there were 272 cinemas containing 312,000 seats, an average of nearly 1,150 per cinema. More than 55 per cent. of these cinemas containing 31 per cent. of the seat accommodation were of houses containing not more than 1,000 seats each.

III. *Film Supply and Distribution.*

1. The returns prepared by the Board of Trade under the Cinematograph Films Act (1927) provide the only reliable source of information for the supply of films to British cinemas.
2. In 1935 (year ending March 31st) the number of subjects "registered" was 1,430, of which 666 were "long" (more than 3,000 ft. each) and 764 were "short." Of the long subjects, 189 were British and 477 were foreign.
3. Measured by length, the total of film registered in the same period was 5,258,000 ft., of which 4,299,000 ft. was "long." Of this 4,299,000 ft., the length of British film was 1,183,000 or 28 per cent. of the total.
4. Since the Cinematograph Films Act came into force, the length of British "long" film registered has increased steadily from 624,000 ft. in the year ending March 31st, 1930, to 1,183,000 ft. five years later.
5. The quantity of British film registered has always been largely in excess of the minimum quantity required to meet quota liability. In the year when the quota liability on the distributor was 10 per cent., the quantity registered exceeded this liability by 70 per cent.; in the last year, when the quota was 17½ per cent., the registrations exceeded the liability by 52 per cent.
6. There has been some marked tendency for foreign "long" films to diminish in recent years. This decline has been compensated for by the new and increasing supply of British film.
7. It is definitely established that the entire excess of British film supply is accounted for by the British companies; all the foreign companies (except one) have acquired only just sufficient of British film as would meet their statutory liability.
8. The best British films and worst foreign films have been distributed by the British companies; the best foreign films and worst British films have been distributed by the foreign companies.

9. Exhibitors as a whole have shown much more British film than the law imposed on them. In the year ending September 30th, 1934, they showed 26.4 per cent. of British film when their statutory liability was only 15 per cent.
10. The average number of times which every British film was screened in the last year was 7,630; the corresponding figure for every foreign film was 6,900.

In bringing this long paper to a close, I feel it important to emphasize that, though a very wide territory has been explored—and that for the first time in any country—there are still many aspects of the economics of the industry to which no mention is made. Particularly I must mention that nothing is said about finance, capital, and numbers employed. These might well form the subject of another communication at a later date, and should prove of great interest.

My acknowledgments are due to many who have assisted me with material and information without which this paper could never have been. In particular, I acknowledge my indebtedness to the officers of the Board of Trade and other Government Departments, to Mr. F. J. Brown of the Cinematograph Exhibitors Association, to Mr. P. Braun of the London County Council, to Mr. C. G. Arnold, to my Secretary, Mrs. L. de Beauchamp, to Mr. W. W. Trendall of the Western Electric Co., and to the Power-Samas Co., for their assistance in tabulating and sorting an immense amount of statistical material relating to cinemas. To all these, and to any others I may have inadvertently omitted to mention, I extend my sincere thanks.

APPENDIX

List of Counties in Great Britain included in each District Subdivision of the Present Paper.

1. *London* (Postal area): comprising London County Council area and portions of the following: Essex, Hertfordshire, Kent, Middlesex, Surrey.
2. *Home Counties*: do. Berkshire, Buckinghamshire, Kent, Middlesex, Surrey, Sussex (excluding portions on counties included in 1).
3. *Eastern Counties*: do. Bedfordshire, Cambridgeshire, Essex, Hertfordshire, Huntingdonshire, Norfolk, Suffolk (excluding portions of counties included in 1).
4. *West of England*: do. Channel Is., Cornwall, Devonshire, Dorsetshire, Gloucestershire, Hampshire, Isle of Wight, Somerset, Wiltshire.

- | | | |
|-------------------------------------|------------|---|
| 5. <i>Midlands :</i> | comprising | Derbyshire, Herefordshire, Leicester-shire, Northamptonshire, Nottinghamshire, Oxfordshire, Rutland, Shropshire, Staffordshire, Warwickshire, Worcestershire. |
| 6. <i>Yorkshire and District :</i> | do. | Lincolnshire, Yorkshire. |
| 7. <i>Lancashire and District :</i> | do. | Cheshire, Isle of Man, Lancashire. |
| 8. <i>North of England :</i> | do. | Cumberland, Durham, Northumberland, Westmorland. |
| 9. <i>North Wales :</i> | do. | Anglesey, Carnarvon, Denbigh, Flint, Merioneth, Montgomery. |
| 10. <i>South Wales :</i> | do. | Monmouthshire, Brecknock, Cardigan, Carmarthen, Glamorgan, Pembrokeshire, Radnorshire. |
| 11. <i>Scotland.</i> | | |

DISCUSSION ON MR. ROWSON'S PAPER

SIR PERCY ASHLEY: Twenty-three years ago I produced my one and only contribution to the public proceedings of this Society; on that occasion Mr. Rowson seconded the vote of thanks. I am very glad that the Council of the Society have given me an opportunity, after so long an interval, of repaying my debt, although I cannot hope to be able to add the accumulated interest.

I have great pleasure in proposing a vote of thanks to Mr. Rowson for his extraordinarily interesting and comprehensive paper—a paper of a kind which I do not think anybody but himself could possibly have produced on this subject. It is a very valuable piece of pioneer work in the investigation of a problem of growing social and economic importance—the problem of the utilization of leisure. Even the most superficial observer of our social life to-day cannot have failed to notice, and some observers are, I think, beginning to be rather perturbed by, the extraordinary increase in the last two or three decades in the demand for entertainment, and in the commercialized provision of entertainment to meet that demand. By “commercialized provision” I mean provision by people whose primary interest is in the financial profits to be derived from it. We are seeing that movement everywhere: the development shows no sign of slackening, and is in fact launching out in new directions. It is evidenced not only in Association football, in which the power of the purse is becoming increasingly supreme, but we have such other developments as Northern Union football, greyhound racing and ice-hockey, and now, if the newspapers are to be trusted, baseball. In this category, though it may, I think, rightly claim to be on a higher level than the others, there is the Cinema, the subject of our meeting to-night and the most outstanding example of the general movement. It was, I think, in about 1896 that the cinema first became a real entertainment proposition; in the forty years since then what was regarded as a passing phenomenon, an entertainment interest in which would decline as its novelty waned, has grown into one of the most striking features of our social life. It

has become the objective of what is called high finance, and has even evoked Government intervention.

The paper which we have had this evening points, more or less directly, to certain characteristics which seem to me to mark out this industry from all the other commercialized forms of entertainment supply.

The first is its appeal to practically all classes of the community and to almost all ages. Most of the other forms of commercialized entertainment appeal, I think it is true to say, only to particular sections or particular types of the community. There is a certain amount of overlapping, but broadly that is true; the cinema alone has a comprehensive appeal. Secondly, facilities for entertainment which it provides are or can be spread throughout the whole country, whilst most of the others are fairly definitely localized. Mr. Rowson referred to the surprise which he thought most people would feel at the very large proportion of small cinemas. I am bound to say that after a good deal of wandering about the country on holiday and at other times, of recent years, that did not surprise me at all. I have been impressed for years past by the very large number of quite small cinemas encountered in our smaller towns, and even in the side streets of the larger towns. Thirdly—it has been touched on briefly, and this is not the place to elaborate it—the cinema, like the theatre which it has so largely displaced, but much more so, is a very powerful means of educational and other propaganda.

Next, and perhaps a more interesting point to this Society, there is the fact that the economic importance of the cinema is not confined to the profits which it gives to its promoters or to the volume of employment which it provides, very substantial though that is. Other forms of recreation entertainment do of course give a substantial volume of employment to industries supplying their requisites; that is perhaps most pronounced in the case of golf. But the important thing about the cinema industry is that it has had a very stimulating effect upon industries dependent for their success upon scientific research, and of great significance in directions other than the Cinema—for example, on the industries concerned with lighting, and with the production of optical instruments of all kinds. That effect of the development of the cinema industry in this country was one of the considerations present to the minds of some at least of those who were responsible for the formulation of the legislation which Mr. Rowson discusses in the latter part of his paper—a consideration which was not in my judgment adequately stressed in the public discussions of that time.

Finally, as is clear from this paper, the industry has developed a very elaborate and complex organization of interests corresponding to those which we know in other industries as manufacturers, wholesalers, retailers, and upon the ordinary problems of the relation between those three classes it has superimposed a number of individual problems of its own. In this connection Mr. Rowson has touched to some extent in this paper, and also in the paper he contributed to our *Journal* last year, on certain aspects of the finance of the industry. I hope that at no distant date he will give us some further

light upon that, upon the commercial structure and financial results of the industry, and particularly on its relation to employment.

There are a few points in the paper on which I have some brief comment to make. In the first place I am not quite sure as to the validity of Mr. Rowson's exclusion of young children under fifteen from his calculations, as representing a "relatively small fraction" of cinema patrons. Broadly that may be so, but I notice in the third volume of the recently-published Survey of Merseyside, in which the cinema is discussed with other forms of recreation, that the authors reach the conclusion that in that area working-class children nearly all attend a cinema about once a week. In Liverpool that must be a material figure.

Then with regard to seasonal variations in attendances, I have some doubt as to whether the March figure is appreciably affected by Lent; and I notice that the average weekly attendance sank to the same level in November. An explanation of that does not readily occur to one; I notice that in the comments following the table Mr. Rowson does not refer to that particular month, but it would be interesting to know if he has any explanation in mind.

I am doubtful also if Scotland should be treated as a whole; I know the cinema trade does so, but it strikes one as unsatisfactory. In Scotland roughly two-fifths of the population is contained within two counties, and the difference of conditions between the Lowlands and Highlands must, one supposes, be very great.

Finally, as to redundancy, I am not quite sure that I understand or appreciate what precisely is Mr. Rowson's conclusion. I gather that he thinks that saturation point has not yet been reached, and is not likely to be reached in the near future. That again, I suppose, may be true of the country taken as a whole, but there must surely be some areas in which a period of contraction, or at any rate of non-expansion, must be looked for. In the Survey of Merseyside to which I have already referred, there is an interesting estimate that in 1931, with three shows a day on six days a week, the cinema seating accommodation in Liverpool was sufficient to enable every man, woman and child of the population of that city to attend the cinema three times a fortnight. The estimated attendance was, however, sufficient only to occupy 44 per cent. of the available seating accommodation per week. That looks like fairly large redundancy, but there may be special conditions of which I am not aware.

Lastly, in regard to the table which Mr. Rowson gives of the new cinemas, I do not know if he can tell us how many cinemas went out during those three years to which his figures refer?

It only remains for me to express my own personal indebtedness to Mr. Rowson, and to invite most cordially the thanks of this meeting for his admirable paper.

MISS IRIS DOUGLAS: I have very much pleasure in seconding this vote of thanks to Mr. Rowson. It is indeed a signal honour for one who hardly ever sets foot inside the cinema, and I feel myself to be a rather unsuitable person in this position, but it gives me very great pleasure, and I should like not only to thank Mr. Rowson, but

to congratulate him on having found a field where there has been no one before him. Not only has he explored fresh ground, but, whereas many of us may succeed in doing that, and only turn up relics of past civilization, he has shown us that this ground may be fertile in much of interest and value.

The tables particularly interesting to me personally have been those in which the seasonal movements are given, because one is able to connect that movement with movements in other expenditure groups,—for instance, the movement in retail trade, railway receipts and postal receipts. I notice also that in the *Observer* on Sunday, one man, speaking from his own experience, said that for the theatres September and the whole of October were the best times in London, which is not far off from the distribution given in the paper. He found that August was fairly good, and so was December. In the retail trade, December is the peak, and August and February the worst times, which agrees closely with the table. October, November and April run about equal.

In postal receipts, April runs pretty smoothly from year to year, August has the worst figures, and October and November are the best months excepting December, so that it appears as if, generally speaking, there is a great deal of expenditure in the autumn months of the year, whether on entertainment or the buying of more tangible goods.

With regard to the density and size of theatres, it is a great pity that we have to have such large districts there, because I cannot help feeling it is not so much the total density of the population, as the way it is agglomerated. Scotland has been singled out, and, as a good Scot, I should like to have said something about that, for there we have one outstandingly large town in which I imagine the bulk of the cinemas are found. I should suppose that in cinemas, as in other things, an experimental period of rapid growth in a new movement occurs first in London and the South, and only later does it spread as far North as Scotland, so that Scotland had relatively few of the small and ill-equipped cinemas which had to be dropped.

In Table XI on p. 86, it struck me how much more closely the correspondence of movement is perceptible in the cinemas containing up to a thousand seats, rather than after that point. Is it that this particular division serves to show the tendency for increasing density of population to be accompanied by a larger size of cinema, but does not reveal how large a cinema corresponds to any given density?

I do not think there are any other points I wish to raise, but merely to express again our gratitude as a Society to Mr. Rowson for his extraordinarily interesting paper.

MR. CHARLES TENNYSON said he was quite incapable of dealing with the subject statistically, but that did not prevent him from feeling grateful to Mr. Rowson for his paper, which was extremely valuable from the practical point of view. He had had the pleasure and privilege of working with Mr. Rowson for a number of years and knew how useful his statistical work was in enabling the perplexing problems of the industry to be solved: his figures and comments would be of real value to the trade in all branches in helping to solve some of its problems which were acute at the present time.

There were certain obvious deductions to be made; one factor brought prominently to his mind was that this was an industry which was applying mass production and mass distribution to entertainment. On p. 115 it was stated that 43 per cent. of the entire cinema admissions were in respect of seats for which the charge for admission did not exceed 6d., and that 37 per cent. were for seats costing not more than 10d. When one realized that the cinema was producing its wares to suit that market (and he supposed there was no film produced which did not aim at satisfying a large proportion of that market), and when one thought of the effect of that on the nature of the product, it was surprising that the standard of the film was as high as it was considering the audience at which it aimed.

With regard to the question of distribution, one found mass distribution coming in through the large theatre circuits, and the problem of the small distributor struggling with the mass distributor. Mr. Rowson expressed his sympathy with the small distributor, and all must share that feeling as regards both the cinema industry and trade as a whole. He also stressed the important point that there might be redundancy in a district. But in this connection one had to consider the quality of accommodation afforded. The fact that in any industry there might be a quantity of relatively inefficient plant in existence was no reason for forbidding the creation of efficient plant.

There was only one other point to which he would like to refer, and that was the figures given by Mr. Rowson—which had never before been given—in regard to the production of quota pictures. There it would be found that the foreign renter was handling exactly the number of British pictures he was forced to handle, whereas the British renter was handling very much in excess, and this, allied to the fact that the foreign pictures distributed by the British renter were much superior to the foreign pictures distributed by foreign renters,—presented a very real problem. The disparity between the two was obvious, when the figures were analysed in this way, and when the figures were taken together they pointed to a grave problem which was exercising the trade at this time, and the Government also, for which some solution would have to be found.

Mr. Tennyson concluded by again expressing his thanks to Mr. Rowson for his extremely valuable paper, which would be of lasting benefit to the industry.

MR. FULLER said that he, like the last speaker, felt himself to be incapable of dealing with the statistical side of the paper, but he felt he owed a debt of gratitude to Mr. Rowson for his excellent work. It was an amazing document, very useful to those people who, like himself, were interested in the cinematograph trade and in solving a number of problems to which attention was constantly being given.

The average figure of attendances gave a remarkable bird's-eye view of the industry and the people for whom it catered. Another interesting figure, which fitted in with the trade's rule of thumb, was that when 40 per cent. of the people in a district had been attracted,

saturation point had been reached. Mr. Rowson expressed that in a different and perhaps more accurate manner, as 22 visits every year for every man, woman or child in the country.

The interesting point for the industry was how to attract more people into the cinema, and that, coupled with the figure of 10d. as the average sum paid for admission, led one to wonder whether the rate would progress by a person going more times, or whether such persons as the seconder of the vote of thanks, who did not go often, could be attracted. The trade was anxious to find out on what lines progress was to be made.

Mr. Fuller shared the view so ably expressed by Sir Percy Ashley as to Mr. Rowson's conclusions on redundancy. Most of the factors entering into the question of redundancy were included in this paper, but he wondered what conclusions the readers of the paper would reach. Affairs in the trade changed very rapidly, and one point to which Mr. Rowson drew attention did seem to be likely to be a predominant factor in the development of this redundancy question. He referred to the purchasing power of the circuits. Very rapidly—especially in the last few months—the trade seemed to be reaching the phase of development observed in other trades that big purchasing forces were able to secure product in preference to a greater number of other people.

The development in building was in the larger size cinemas, seating 1500 to 2000, which seemed to be the economic size now building, and that forced one to the conclusion that there would be development. When one looked at Table V, giving the cinemas in Great Britain classified by Number of Seats, it would appear that one might be forced to the conclusion that there would be expansion, allowing for a period in which patronage might be stationary, as Sir Percy Ashley had suggested, and that the development would be at the expense of cinemas seating from 600 to 1000. It seemed probable that the smaller cinemas could always continue by effecting economies, if necessary.

Mr. Fuller said he would like to refer briefly to Table XXI. Mr. Rowson did say that in one important respect the figures in that table might be misleading. He himself had tried to understand what the figures did mean, and must frankly confess that he had given it up; that was the one table which did not seem to fit in practically with the experience of the industry. It reminded him of those tables that showed a man to be getting better off, when his bank balance was going down. Actually the trouble found arose from the selection of pictures. Generally production had increased relatively slowly in British pictures, and there was greater competition for them. If there were five cinemas, there must be five pictures to show, and when one took the numbers of pictures instead of the millions of '000s, it did not work out in quite the same way.

The concluding remarks of Mr. Rowson concerning the relative standards of the British and foreign pictures were exceedingly admirable in the way he expressed it, and it was a very pleasant thought that a paper of this nature should have the vote of thanks proposed by Sir Percy Ashley, as it was very interesting to refer to

the fact that when legislation was before the House of Commons, Sir Percy Ashley was in charge of the Bill at the Board of Trade, and he took a great part in promoting that measure, which had worked out so admirably.

MR. A. P. L. GORDON wished to associate himself with the vote of thanks, not only for the great quantity of work which Mr. Rowson had brought before the Society, but also for the colossal amount which he had foreshadowed. He hoped, therefore, that if he pointed to one or two things which he trusted would appear in future papers on this subject, it would be taken as suggestion rather than criticism. He was especially glad to hear that Mr. Rowson had devised a way of ascertaining the number of times per year, or week, different types of people went to the cinema, and had mentioned a possible addendum to the paper to cover this point. There appeared to be seating capacity enough for everyone to go to the cinema once in roughly five days, whereas, in fact, the population actually go, on an average, about once a fortnight.

In trade terms, Mr. Rowson's paper was a "still" rather than a motion picture; and possibly the trend of development in the trade might throw some degree of light upon the question of seating redundancy. For every cinema there was presumably one particular show each day which more or less governed the necessary seating capacity; and the exhibitor could scarcely expect to fill every house as well as he filled his crucial house. On the other hand, he did aim, as had been done by the reduction of prices at certain times of day in many London cinemas, at getting an economic return from his other shows. Nevertheless it was a solemn thought that there was a seating capacity fully three times the size of what was used. Admittedly the industry had participated in a change of national habits, and might be expected to be, to some extent, ahead of the demand. But it seemed still to be worth enquiring how far this change of national habits would continue. It would certainly increase with the penetration of the cinema into areas not previously covered. It would be interesting to have some kind of information as to the potentialities of this penetration; and as to the extent to which the real fan population of the cities was changing from (say) four to five attendances per week. These were largely intangibles, but any solution would throw a considerable light upon whether there really was an effective redundancy, such as the figures tended to show.

He hoped also that Mr. Rowson would, some time or another, deal with the financial structure of the industry, in particular relation to this problem. From the public accounts of the leading companies, it did not appear that they considered that there was any effective redundancy. He drew this rather hazardous inference from the very small allowances made by the Companies for the depreciation and obsolescence of their exhibiting properties. He had in mind one particular Company, which was purely an exhibiting company, with plant and properties valued at a little over £5½ millions; in a full year's trading, the Company appeared to reserve profits, including

the Depreciation account, to the extent of only $2\frac{1}{2}$ - $2\frac{3}{4}$ per cent. on this valuation. This seemed to allow the properties a life of 35-40 years, which, in so rapidly developing an industry, was possibly rather an optimistic hope. It was certainly the main ground for a good deal of the public's lack of confidence in the financial stability of the industry, and Mr. Gordon ventured to stress that this was a point on which a certain amount of clarification would be particularly welcome.

DR. C. O. GEORGE said he would like to join in the chorus of praise offered to Mr. Rowson for his able paper, which would doubtless prove most interesting to a wide circle of readers. The first point that struck him was that Part I was based on details of entertainments duty, which were, in Mr. Rowson's words, authoritative estimates. Might one ask who was the high authority responsible for these estimates, or must the Society, like an even more august body in recent days, rest content in the belief that it would be more than satisfied if lips could only be unsealed? Hitherto, requests for such details of entertainments duty receipts had met with the reply that figures were not available because there was no means of deciding on the class of entertainment for which stamps or stamped tickets might be used, and it would, therefore, be interesting to know how this difficulty had been overcome.

Passing to Table I, Dr. George said that it did not appear to be quite complete, as there were about six million tickets (i.e. a little under 1 per cent.) not accounted for. It did not seem likely that the six million deficiency was due to the omission of tickets exceeding 102 pence, the maximum shown in the table, which would have affected the average, nor was it likely to be due to prices insufficiently important to be separately included. Was it due to transfers and complimentary tickets?

This table, although apparently based on tickets sold to "certified" cinemas only, had been used as a basis for calculating a multiplier for both "certified" and "non-certified" cinemas. He knew nothing about cinemas, but there did seem reason to doubt whether the proportions at the lower prices were likely to be quite the same in the "non-certified" houses, described as "generally speaking, the smaller cinemas with a lower average of admission prices," as they were in the "certified" houses.

Doubts on this point seemed to be increased when one compared the table with Table II, showing "Estimated distribution of cinema admissions in 1934." Presumably the first column of the latter table was slightly incorrect, as the table included all admissions, and it might be assumed that it would be amended, before final printing, the phrase "exceeding 4d. and not exceeding 7d." being substituted for "6d. and 7d.," and so on up the scale. If these amendments were made, there appeared some apparently puzzling differences between this table and Table I. For example, admissions of "2d. and under" were only 1.41 per cent., as compared with 1.80 in Table I, while admissions of 3d. were 7.71 per cent., as against a total of 3.90 in Table I. Again, whereas the percentages

shown against the admission rates of "16d." and "18d." in Table II were respectively 7.69 and 2.36, the corresponding figures in Table I, when aggregated, almost reversed these percentages, and while the "30d." percentage was shown as 1.90, the corresponding items in Table II totalled 4.45. One wondered which set of figures had been combined with those of Table I to get these results, and also how such wide divergencies arose, seeing that Table I already covered more than two-thirds of the total admissions.

Passing to Table III, Dr. George suggested it illustrated the difficulty of allocating entertainments duty receipts not only to particular forms of entertainment, but also to any particular period. For example, the table was based on "receipts collected" during weeks ending on the Fridays in any given month, but was there not a lag between admission to cinemas and the date the relevant duty was actually paid, thus making it impossible to draw fine lines between months on such a basis? Would not, for instance, admissions on any given Monday appear in the receipts for the week ending eleven days later? Furthermore, one wondered how the receipts from stamps and stamped tickets, which might be purchased in advance, had been ascertained and allocated.

As time was getting on, he would conclude by adding a little to what Sir Percy Ashley and Miss Douglas had said about Table XI. One did feel there was some reason to doubt the validity of deductions drawn from this table, first, because of the small number and heterogeneity of the areas; secondly, the figures for the London area had been excluded in calculating the correlation coefficients, presumably because of their effect on the result, but one wondered, on looking at the figures in the table, whether the exclusion of Lancashire, the next most populated area, would not have substantially changed the appearance of the coefficients; thirdly, if one compared the figures for Scotland, the least densely populated area, with those for Lancashire, the most densely populated area included in the correlation calculations, one was struck not so much by their differences as by their similarities. In fact, such differences as existed seemed on the whole to contradict the suggested "law," and it was noticeable that there was a larger proportion of "large" cinemas in Scotland than in Lancashire.

Dr. George concluded by once again thanking Mr. Rowson for one of the most interesting papers to which he had ever listened.

THE CHAIRMAN did not think it would be fair to call upon any other speaker, but before putting the vote of thanks to the meeting, he would give the ritual caution that it was not necessary for the reader of the paper to reply at length to criticism, as he would have ample space in the *Journal*.

He (Professor Greenwood) was tempted by the last speaker to say that he found Table XI a little mysterious. If the problem to be solved were to measure the relation between density of population and seating accommodation of different size, he did not quite see why a single coefficient of correlation deduced from the whole frequency distribution would not have been adequate.

There was nothing he could add to the discussion excepting to say that one of Mr. Charles Tennyson's remarks had rather jarred upon him. Mr. Tennyson seemed to be surprised that although most of the patrons of cinemas paid small sums for their seats, the literary and artistic quality of pictures which were popular was not so very bad. He himself felt no surprise. The most popular dramatic writer in the country was Shakespeare, and the authorized version of the Bible and Bunyan's *Pilgrim's Progress* had been best sellers through many generations. "Uneducated" people received quite as much pleasure from fine books, pictures and music as their supposed superiors, when they were given the opportunity of reading, seeing or hearing masterpieces. The better and more artistic pictures were the more popular they would be.

He had much pleasure in putting the vote of thanks to the meeting; this was carried unanimously.

MR. ROWSON replied, in writing, as follows:—

The reception of my paper has exceeded my expectations, and has proved how great the public interest is in the cinema as an institution, and how great was the desire for authentic information about the industry as a whole. Economic forces and tendencies, whether in the field of sociology or politics or industry, must be capable of being measured before they can be enlisted as an instrument for any desired purpose.

One of my critics complains that the survey contained in the paper is only a "still." This is true, but only in the same sense as an ordnance map is a representation of all the physical features of the territory to which it relates. It is particularly appropriate to a cinema survey, because after all the illusion of continuous motion which the cinema provides is merely the result of a succession of still pictures. I am sanguine enough to hope that periodical surveys of the same area will provide in time a remedy for that defect in my present survey to which my critic, not incorrectly, draws attention.

I am grateful to Sir Percy Ashley for the many favours of which he has made me the recipient since he became interested, in an official capacity, in the film industry. I am grateful to him also for his generous measure of approval of my latest effort. Again, I am obliged to him for reminding me and others of the beneficent by-product of the cinema in the course of its development which arose from the stimulus it gave to scientific research in so many directions. As an instrument of research the cinema has been employed in natural history, in surgery and microscopy, in ballistics, and in the study of many other physical and chemical problems. It has also demanded research for its own needs and advantage from the manufacturers of lenses, celluloid, photographic emulsions, electric-light apparatus, and microphones and loud-speakers.

Dr. George has put a very cogent question to me, the explanation of which is somewhat obscure in the paper as originally written. It is quite true that the figures in the first column of Table III do not give a clear indication of the method by which I reach the figures in the second column. As a matter of fact, from further information

received subsequent to the reading of the paper, I have been compelled to recalculate the table. The figures in the first column of Table III generally relate to collections received up to the last Friday in each month, but these collections relate to payments made by the public (*i.e.* admissions) up to the previous Saturday night. Returns referable to any calendar month, therefore, are composed of figures partially included in the previous month and partially included in the following month. The present month of December, for example, contains thirty-one days, which include five Sundays and Christmas day, leaving twenty-five weekdays. The last Friday occurred on the 27th and the previous Saturday on the 21st, therefore eighteen week-days out of the twenty-five will be derived from the December collections, and the other seven from the January collections. The sum of these two derivatives is assumed to give approximately the actual December collections.

Dr. George's question about the discrepancy of some six million tickets is explained, as he suggests, by the inclusion, not of "transfers," but of "complimentaries" and "re-admissions," which, of course, represent no further box-office receipts.

As a result of the ballot taken during the meeting the candidates named below were unanimously elected Fellows of the Society:—

Ronald Stanley Adams.
Fred Henry, LL.D.
Antonio Lopez-Romero.

George Frederick Parkhurst
Trubridge, M.Sc., Ph.D.
Roland Wilson.

MISCELLANEA.

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INVERSE PROBABILITY.*

By L. ISSERLIS.

INVERSE probability is the traditional name for problems dealing with the probabilities of causes. There has been in the past and there continues to be to-day a good deal of discussion as to the legitimacy of the method of inverse probability and as to the applicability of Bayes' theorem, which is one of its corollaries. Chrystal, for example, includes a chapter on probability in his algebra but omits all reference to inverse probability. He says in his Preface to Vol. II: "In the chapter on probability I have omitted certain matter of doubtful soundness and of questionable utility."

Among modern mathematical statisticians, R. A. Fisher takes up the same attitude and has introduced new concepts such as "likelihood" and "fiducial probability" in order to provide a critical apparatus wherewith to judge the merits of different hypotheses in the light of observations. The problem is that of scientific inference, or, as Jeffries puts it, the question we have to answer is, "Can we learn from experience?"

The practice of scientists shows that in their view the answer is in the affirmative. If any scientist held a different view he would give up his job. My own view is that such difficulties as have arisen are due to the fact that in the applications of the theory of probability to scientific problems, the wrong question is frequently put, with the consequence that the answer is unintelligible. The business of science is to frame useful questions which can be usefully answered.

* The substance of a lecture to the South Midland branch of the Mathematical Association, at Birmingham, Oct. 18, 1935.

In the classical theory, inverse probability is merely the law or postulate of the multiplication of probabilities. Whether we speak of a theorem or a postulate depends, of course, on the fundamentals on which we base the whole subject.

Adopting the notation :—

$P(A)$ = probability that proposition A is true.

$P(A, B)$ = probability that proposition A is true, when it is known that proposition B is true, and

$P(AB)$ = probability that propositions A and B are both true.

Then the addition and multiplication laws may be written—

- (i) If the truth of A implies the truth of one and one only of $B_1, B_2, \dots B_i \dots B_k$

$$P(A) = \sum_{i=1}^k P(AB_i).$$

- (ii) $P(AB) = P(A)P(B)$ if the truth of proposition A is independent of the truth of proposition B , and in general

$$P(AB) = P(A)P(B, A) = P(B)P(A, B).$$

Combining (i) and (ii) we get

$$P(B_i, A) = P(B_i)P(A, B_i) = \sum_{i=1}^k P(B_i)P(A, B_i).$$

This is the probability of "cause" B_i .

If C like A is true when one and one only of $B_1, B_2, \dots B_k$ is true, then

$$P(C, A) = \sum_{i=1}^k P(B_i)P(A, B_i)P(C, B_i, A) = \sum_{i=1}^k P(B_i)P(A, B_i).$$

This is Bayes' theorem regarding the "probability of a future event." (1)

The theorem is a simple, direct and correct consequence from the definitions and postulates.

Unfortunately, the occasions on which it can be usefully employed are very rare.

Whitworth and, more recently, Burnside give many examples—suitable for the examination room. Here is a typical one from Markov. (2)

We are given 14 urns. Of these, 9 are alike and contain 5 white balls and 8 black balls each. The other 5 urns are similar in appearance to those in the first group of urns but contain 11 white balls and 2 black balls each.

An urn is chosen at random. From this urn a ball is drawn at random and is found to be white. The drawn ball is not returned.

Required the probability that if another ball is drawn at random from this urn it will be white.

Adopting the above notation we call choosing one of the first group of urns, event B_1 , and choosing one of the second group of urns, event B_2 . The drawing of the first white ball from the chosen urn is event A . The drawing of a second white ball from this urn is the "future" event C . Then Bayes' theorem gives us immediately the "probabilities of causes."

$P(B_1, A) = 9/20$ and $P(B_2, A) = 11/20$, i.e. the probabilities after the result of the first draw is known, that the chosen urn belonged, in fact, to the first or second group. Further, Bayes' theorem gives $P(C, A) = \frac{7.9}{1.2.0}$. We note that $P(C) = 50/91$, so that we do in this trivial case learn from experience. The fact that a draw from one of the urns has given a white ball has increased the probability of a white ball at a future draw from

$$\frac{50}{91} \text{ to } \frac{7.9}{1.2.0}.$$

Why is this example trivial, and Bayes' theorem though true of little use?

In practice we do not know $P(B_1)$ and $P(B_2)$ —the proportions of the two kinds of urns.

What has deservedly brought the method into disrepute—and the great Laplace has fallen into the trap—has been

- (1) the attempt to give plausible values to $P(B_i)$;
- (2) the attempt to show that results based on Bayes' theorem are very nearly the same whatever (plausible) values are given to the $P(B_i)$.

To illustrate I choose the so-called "Law of Succession." An event has happened m times and failed l times in $m + l = n$ trials. What is the probability that it will happen m' times and fail l' times in the next $m' + l' = n'$ trials?

Prévost and Lhuillier (3) apply Bayes' theorem to this problem. Their method is as follows:—

Consider a whole system of urns, each containing N black and white balls. The draw of a black ball is "the happening of the event." The urns may contain 0, 1, 2, . . . , N black balls. That the urn should contain i black balls is the event B_i .

The authors assume $P(B_i)$ is constant and therefore equal to $\frac{1}{N+1}$, and applying Bayes' theorem deduce

P (m' blacks out of n' in any order, when first draw gave m blacks out of n in a specified order)

$$= \binom{n'}{m'} \frac{1}{(n + n' + 1) \binom{n + n'}{m + m'}} \int \frac{1}{(n + 1) \binom{n}{m}} \\ = \binom{n'}{m'} \int_0^1 x^{m+m'} (1-x)^{n-n'} dx \int_0^1 x^m (1-x)^n dx,$$

and in particular that if $m' = 1$, $n' = 1$, $v' = 0$, the probability of 1 success in 1 trial after m successes in n trials is

$$P(1 \text{ out of } 1, m \text{ out of } n) = \frac{1 \cdot (n + 1) \binom{n}{m}}{(n + 2) \binom{n + 1}{m + 1}} = \frac{m + 1}{n + 2}$$

This is the famous Law of Succession.

If a horse has won m times in its first n races, the probability that it will win its next race is $\frac{m+1}{n+2}$. This result is absurd, not because Bayes' theorem is wrong, but because the assumption that all possible compositions of the "universe" are equally likely is absurd.

Now in the direct problem, if the probability of a success in any trial is p (the same for all trials), then the probability of m successes in n trials is $\binom{n}{m} p^m q^{n-m}$, where $q = 1 - p$, i.e. the probabilities of 0, 1, 2, . . . , n successes are given by the terms of $(p + q)^n$.

James Bernoulli (4) showed, by summing a number of terms on either side of the greatest term of this binomial series, that if m is the number of successes in n trials, with the probability of a success at each trial equal to p , then

$$P\left(\left|\frac{m}{n} - p\right| \leq \varepsilon\right) > 1 - \tau_1 \text{ if } n > n_0.$$

He gave the numerical example $p = \frac{2}{3}$,

$$\varepsilon = \frac{1}{50},$$

$$\tau_1 = 0.001,$$

and found

$$P\left(\frac{19}{50} \leq \frac{m}{n} \leq \frac{21}{50}\right) > 0.999$$

$$\text{if } n > n_0 = 25,550.$$

The Russian mathematician Markov showed that a slight modification of Bernoulli's method would give $n_0 = 16,655$. A closer limit

was developed with the aid of Stirling's theorem by De Moivre, (5) at least for the case $p = \frac{1}{2}$, and perfected by Laplace (6) in the form

$$\lim_{n \rightarrow \infty} P\left(p - t_1 \sqrt{\frac{2pq}{n}} < \frac{m}{n} < p + t_2 \sqrt{\frac{2pq}{n}}\right) = \frac{1}{\sqrt{\pi}} \int_{t_1}^{t_2} e^{-t^2} dt$$

and in particular that

$$P\left(p - t \sqrt{\frac{2pq}{n}} < \frac{m}{n} < p + t \sqrt{\frac{2pq}{n}}\right) = \frac{2}{\sqrt{\pi}} \int_0^t e^{-t^2} dt + \frac{1}{\sqrt{2\pi npq}} e^{-t^2} \text{ approximately.}$$

The fact that this is only an approximation makes precise deductions difficult, but it can be shown that if this result is applied to Bernoulli's example we get

$$P\left(\frac{19}{50} < \frac{m}{n} < \frac{21}{50}\right) > 0.999$$

if $n > n_0 = 6520$.

A tentative method has to be employed; n_0 being assumed equal to 6520, it is shown that the fraction on the right-hand side lies between 0.999031 and 0.999028.

Improvements have been effected in modern times on this inequality, notably by Liapounov and Khintchine, (7) but if a "best" value exists it has not yet been discovered. Linfoot's result is referred to below.

Bernoulli used his theorem inversely.

Todhunter says, "this use of the theorem was that which Leibnitz found it difficult to admit."

Laplace does the same. He assumes that in his formula written in the form

$$P\left(p - t \sqrt{\frac{2pq}{n}} < p' < p + t \sqrt{\frac{2pq}{n}}\right) = \frac{2}{\sqrt{\pi}} \int_0^t e^{-t^2} dt + \frac{1}{\sqrt{2\pi npq}} e^{-t^2}$$

where p is the *a priori* probability and p' the observed ratio, we may interchange p and p' and so get a value for the probability that p should lie between specified limits. Laplace feels that this is unsound, promises to return to the subject, does so, and then uses Bayes' theorem with equidistribution of *a priori* probabilities! He gets

$$P\left(p' - t \sqrt{\frac{2p'q'}{n}} < p < p' + t \sqrt{\frac{2p'q'}{n}}\right) = \frac{2}{\sqrt{\pi}} \int_0^t e^{-t^2} dt$$

Todhunter says, "The two results differ slightly—Laplace makes no remark—but it is of interest theoretically." In one form or another Laplace's error has persisted to the present day.

R. A. Fisher endeavours to avoid it by "tabulating" assumed values of p .

Calling the observed event (*e.g.* the existence of x black balls in a draw of n) the sample, he calls "the relative frequencies with which such values of the hypothetical quantity p would in fact yield the observed sample" the likelihoods of p .

If $x + y = n$,

Likelihood of $p = A p^x (1 - p)^y$.

His estimate of p for the universe is that for which the likelihood is a maximum.

In his memoir, "Mathematical Foundations of Theoretical Statistics," Fisher (8) says:

"We do not and cannot know from the information supplied by the sample anything about the probability that p should lie between any named values."

I show below that this view is unduly pessimistic.

If we are given the *a priori* p —the probability of the event in the sampled universe, we do not know *exactly* what to expect in the sample—the best we can do is to get inequalities such as Bernoulli's and try to make them sharper as Laplace did or give them a more rigorous form. An example of the latter is Linfoot's (9) result: if p applies to an infinite universe and p' to a sample of size n , then

If $2npq \geq 7$,

$$P(p - t\sqrt{2pq/n} \leq p' \leq p + t\sqrt{2pq/n}) > 1 - 2e^{-\frac{t^2}{15}} \left(1 + \frac{\sqrt{2npq}}{t}\right).$$

Bernoulli's, Laplace's, and the later results are not directly suitable for inversion. There is, however, an elementary Lemma due to the Russian mathematician Chebyshev—

$$P(|y| > A) < Ey^a/A^a,$$

where A and a are arbitrary positive numbers and Ez is the mathematical expectation of z

$$E(z) = \sum P(z = Zi)Zi.$$

For draws of n' balls from a universe containing n balls of which pn are black and qn are not black, let $p'n'$ be number of black balls in the sample, then

$$E(p'n' - pn)^2 = pqn' \frac{n - n'}{n - 1}$$

reducing to pqn' when $n = \infty$. Hence Chebyshev's Lemma gives

$$P(|p'n' - pn| < A) \geq 1 - \frac{pqn'(n - n')}{A^2(n - 1)},$$

or, if $A = t\sqrt{pqn'}$,

$$P(|p - p'| < t\sqrt{pqn'}) \geq 1 - \frac{1}{t^2} \frac{n - n'}{n - 1} \quad . \quad . \quad (A)$$

Applying this to Bernoulli's example $p = \frac{2}{3}$ we get

$$P(\frac{1}{30} < p' < \frac{29}{30}) > 0.999$$

if $n > n_0 = 600,000$.

This is not nearly so good as Bernoulli's 25,550, Markov's 16,655 or Laplace's 6520, but the inequality (A) has the advantage of being easily reversed so as to give

$$P\left(p - p' - \frac{(p' - \frac{1}{2})t^2}{1 + t^2} \frac{n'}{n} < \frac{t\sqrt{n'}}{1 + t^2} \frac{n'}{n}\right) \\ \sqrt{p'q' - \frac{t^2}{4n'}} \geq 1 - \frac{1}{t^2} \frac{n - n'}{n - 1} * \quad . \quad . \quad (B)$$

This gives the probability that p should be between certain limits when p' is known—showing that Fisher's pessimism was unjustified.

In Bernoulli's example, if $p' = \frac{2}{3}$ and $n' = 600,000$, we may take $t^2 = 1000$ and deduce

$$P(0.38016 < p < 0.42016) \geq 0.999.$$

Given $p = 0.4$ in the universe in Bernoulli's example, we found that all we knew about p' in the sample was that

$$P(0.38 < p' < 0.42) \geq 0.999$$

if $n' > 600,000$.

Given $p' = 0.4$ in the sample, we now know about p in the universe that if $n' > 600,000$, then

$$P(0.38016 < p < 0.42016) < 0.999.$$

No doubt "better" inequalities could be obtained if we inverted Linfoot's inequality, but the algebra would be harder.

If in (B) we put $n = \infty$ $n' = 1$ $p' = 1$, then

$$P\left(1 - \frac{1}{1 + \frac{1}{t^2}} < p < 1\right) \geq 1 - \frac{1}{t^2},$$

t is at our choice, put $t = \sqrt{2}$, then

$$P(\frac{1}{3} < p < 1) > \frac{1}{2},$$

i.e. an event has happened once, the probability, that its probability is greater than $\frac{1}{3}$, is greater than $\frac{1}{2}$, or the betting is more than evens that the odds against the event are shorter than 2 to 1.

* This and similar methods of reversing inequalities connected with probability statements are developed with great effect in Prof. O. Anderson's recently published *Einführung in die Mathematische Statistik*, reviewed elsewhere in the current number of this *Journal*.

To take another example, let us suppose that all we know about a pack of cards is that it contains 52 cards and that some of these are trumps. A hand of 13 cards is dealt and it is observed that it contains 2 trumps. What do we know now about the constitution of the pack?

$$\text{Put } n = 52, n' = 13, p' = \frac{2}{13},$$

then

$$P(0.1718 < p < 0.235) \geq \frac{4}{17},$$

or, if x is the unknown number of trumps in the pack,

$$P(8.9 < x < 12.2) \geq \frac{4}{17}.$$

Either of these inequalities gives the answer. The first is in the form of a statement about the probability of a probability. The probability, that the probability of drawing a trump is between 0.17 and 0.24, is greater than $\frac{4}{17}$.

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References (1), (3), (4), (5), (6) are "second-hand" from Todhunter, *History of the Mathematical Theory of Probability*, 1867.

DANIEL BERNOULLI AND J. H. LAMBERT ON MORTALITY
STATISTICS.

By A. LINDER.

I

IN his *Contributions to the History of Statistics* Professor Westergaard points out the weighty contribution made by Daniel Bernoulli to the theory of statistics. Bernoulli was the first author who used the continuous method for solving statistical problems. Westergaard remarks that Bernoulli introduced the *force or intensity of mortality** to obtain elegant formulæ in a certain connection. It seems to me that this remark is inexact. In fact, Daniel Bernoulli used the word "intensité," but the phrase intensity of mortality was not used by him at all.

In the following note I shall first analyse the memoir of Daniel Bernoulli in question, and then refer to the work of the Swiss mathematician Johann Heinrich Lambert, who was the first to direct attention to what he calls "Lebenskraft," that is, the force of vitality or the reciprocal of the force of mortality :

$$(\text{force of mortality} = \mu_x, \text{force of vitality} = \frac{1}{\mu_x}).$$

Later on, Gomperts in his well-known paper ("On the Nature of the Function Expressive of the Law of Human Mortality, . . ." †) used the term "intensity of mortality," and formulated his law of mortality

$$l_x = kg^{e^x},$$

which he deduced with the aid of the intensity of mortality.

II

Daniel Bernoulli (1700–1782) published in 1766 an "Essai d'une nouvelle analyse de la mortalité causée par la petite vérole et les avantages de l'inoculation pour la prévenir." In this treatise the continuous method is for the first time used to solve a problem of mortality statistics.

* Force or intensity of mortality is equal to $\mu_x = \frac{l'_x}{l_x}$, where l_x is the number of survivors at age x .

† *Phil. Trans., Roy. Soc.*, London, 1825, p. 513.

Bernoulli tried to calculate how many persons would never be attacked by small-pox. As he knew nothing of the morbidity and the mortality of small-pox, he assumed that neither varied with age. During a year, of n persons not previously attacked, one would contract the disease, and of m attacked one would die.

Out of ξ persons surviving at age x , s may never have been attacked. The diminution of the last number in an interval dx will be $-ds$. In an interval dx a number of

$$\frac{s dx}{n}$$

will be infected by small-pox. According to his assumptions, the number of persons dying after having contracted small-pox will be

$$s dx$$

Out of the total of ξ survivors $d\xi$ will die. From ξ survivors

$$-d\xi - \frac{s dx}{n m}$$

will die from some cause of mortality other than small-pox. From s persons who have never been attacked by small-pox

$$- \frac{s d\xi}{\xi} - \frac{s s dx}{\xi n m}$$

will die from any cause of mortality other than small-pox.

Ultimately, the diminution of the non-attacked becomes

$$-ds = \frac{s dx}{n} - \frac{s d\xi}{\xi} - \frac{s s dx}{m n \xi} \quad . \quad . \quad . \quad (1)$$

Here Bernoulli says: "On voit aussi que j'entends proprement par

$$\frac{1}{n} \text{ et } \frac{1}{m}$$

l'intensité des périls à prendre la petite vérole pour ceux qui ne l'ont pas encore eu, et à en mourir lorsque on en est attaqué, en supposant ceux qui l'ont eu une fois hors de péril de la reprendre."

The section of Bernoulli's work cited appears to show that he had not discovered and applied what we call to-day the intensity of mortality and the intensity of morbidity.

Continuing his analysis, Bernoulli finds the solution of the differential equation (1), putting $s = \xi$ for $x = 0$,

$$s = \frac{m}{(m-1)e^{\frac{x}{n}} + 1} \xi \quad . \quad . \quad . \quad (2)$$

With this formula Bernoulli solves the problem theoretically. He calculates an example, putting $m = n = 8$, and using as his table of mortality that prepared by Halley. English readers will find a similar summary of Daniel Bernoulli's contribution to this subject on pp. 225-6 of Todhunter's *History of the Theory of Probability*.

III

In 1765 J. H. Lambert (1728-1777) began to publish his "Beiträge zum Gebrauche der Mathematik und deren Anwendungen," three volumes full of new ideas. The statistician finds in this work the first attempt to build up a *theory of error*. Moreover, it contains a chapter on *interpolation*, and notes on *mortality, births and marriages*. Lambert very clearly describes the *stationary population*; he distinguishes between persons born in the same year and dying at a *given age* and persons born in the same year of birth and dying in a *certain space of time*. He calculates *independent probabilities* according to the formula

$$\frac{\Delta r}{r} = \frac{\Delta y - v}{y - \frac{1}{2}v} \quad . \quad . \quad . \quad . \quad . \quad (3)$$

where r indicates the number of survivors, Δr the number of persons dying if small-pox were not present. The total number of survivors is y , Δy the number of deaths if all causes of death should occur. Small-pox causes v deaths. Equation (3) is the formula now in common use.

Concerning the *force of vitality* ("Lebenskraft") I would make some preliminary remarks on Lambert's table of mortality. Lambert constructed this table of mortality using numerical data given by Süssmilch and interpolating the values between the ages 0, 2, 5, 10, 20, 30 and so on. In his table Lambert gives seven columns:

- (1) age,
- (2) number of persons dying,
- (3) survivors,
- (4) sum of survivors,
- (5) one dies out of . . .
- (6) mean age,
- (7) age at which half of the persons are dead.

The numbers in column 6 are calculated by dividing the column 4 by column 3 and adding the corresponding ages. Column 5 gives the reciprocal values of q_x (q_x = probability of mortality).

Lambert writes that "the numbers in the fifth column deviate, not only in the first year, appreciably from the true length of the

subtangent." "This subtangent is the real measure of the *force of vitality* (Lebenskraft)." "The force of vitality increases rapidly to the 16th or 17th year. From here it also decreases very rapidly to 25 years, then more slowly and from the age of 50 again somewhat less rapidly." "In the middle of the eighth decade it seems to increase again somewhat, so that it is not smaller at the age of 95 than at the age of 83."

It may be added that Lambert gave two functions to approximate the law of mortality. The number of survivors is represented by

$$y = 26,950 - 985 \cdot 7x + 9,709150x^2 - 0.03427x^3 \\ - 0.0027017x^4 + 0.000066635x^5.$$

The second time he writes :

$$y = 10,000 \left(\frac{96 - x}{96} \right)^2 - 6176 \cdot e - \frac{x}{31,682} - e^{-\frac{x}{2,13111}}.$$

IV

As one may see from these few examples, Lambert, man whom Kant called the greatest philosopher of his time, who showed how to measure light and heat, who proved that π is an irrational number, is also one of the most interesting writers on theoretical and population statistics. It does not lie within the scope of the present note to treat Lambert's contributions to statistics in full detail, but nevertheless I wished to draw attention to the fact that in this field of science as in the others to which he devoted his energies, he is worth studying even in our days.

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THE PRECISION OF INDEX NUMBERS.

By E. C. RHODES, D.Sc.

IF it be assumed that the various authorities which sponsor the computation of (say) Wholesale Price Indices in a particular country are all attempting in their various ways to measure the same thing, we can, from a consideration of the results of their calculations, obtain some idea of the degree of precision of their figures.

One authority chooses a certain period as base to which subsequent periods are referred; this authority takes account of a chosen amount of information relating to prices of commodities, and certain arithmetical computations lead to the indices, which give us an idea of what changes have taken place. Another authority may differ from the first in all these respects, may use a different base, may use different matter and may use a different method of computing the indices. We may contrast the Board of Trade Index and the *Statist* Index in all these respects.

But whatever the processes used, all these indices are alike in this respect, they are all indirect attempts at measurement of an elusive quantity. We may therefore suppose that if I_t stands for the number which is the subject of estimation at a particular period of time (t), and if X_t represents the index calculated for an authority, then

$$X_t = r_a I_t + A_t,$$

where r_a is a factor peculiar to this authority, introduced into the equation because we have no knowledge of the value of I_t or the units in which it should be measured, and because the value of X_t is dependent on the base period to which the index is referred. A_t in the above equation is introduced to allow for the possibility of wrong estimation of the index by a constant amount as time goes on or by a variable amount. A_t may be considered to represent a systematic error and a random error in the computations of the index. The factor r_a is supposed to be constant as time changes, but A_t alters with time.

Similarly, we may suppose that the index calculated for another authority (Y_t) is given by an equation

$$Y_t = r_b I_t + B_t.$$

Here r_b is a factor peculiar to the second authority, constant with time, and B_t represents the error (systematic and random) introduced into the computation of the index corresponding to the period (t).

Similarly, with a third authority we should assume,

$$Z_t = r_c I_t + C_t.$$

Let us suppose that we have the results of such computations for a number of authorities over a long period of time, *i.e.* let us suppose t varies from 1 to m . If we average the X 's, the Y 's, etc., for these values of t , and refer to these averages as \bar{X} , \bar{Y} , etc., and call the averages of the I 's, the A 's, B 's, etc., \bar{I} , \bar{A} , \bar{B} , etc., we may write and

$$\bar{X} = r_a \bar{I} + \bar{A}, \quad \bar{Y} = r_b \bar{I} + \bar{B}, \text{ etc.}$$

all var. we refer to deviations of these variables from their averages $\sqrt{S(i_t^2)}$ all letters, *i.e.* let us call $X_t = \bar{X} + x_t$, $Y_t = \bar{Y} + y_t$, etc., $I_t = \bar{I} + i_t$, $A_t = \bar{A} + a_t$, $B_t = \bar{B} + b_t$, etc., we may write

$$x_t = r_a i_t + a_t, \quad y_t = r_b i_t + b_t, \text{ etc.} \quad (i)$$

Now if we assume that the random errors introduced into the calculations of the indices are independent of one another, and of the quantity measured, *i.e.* if we suppose that $S(a b_t)$, $S(a c_t)$, $S(b c_t)$, and all such sums of products of the random errors are zero, and that all such sums of products such as $S(i_t a_t)$, $S(i_t b_t)$, etc., are also zero, the summations being for all values of t from 1 to m , we obtain, when we multiply the quantities x , y , etc., in pairs and add

$$S(x_t y_t) = r_a r_b S(i_t^2), \quad S(x_t z_t) = r_a r_c S(i_t^2), \text{ etc.}$$

using equations (i). If there are n index numbers computed for n authorities, we have $\frac{n(n-1)}{2}$ equations of this type. These equations may be written

$$R_a R_b = S(x_t y_t), \quad R_a R_c = S(x_t z_t), \text{ etc.} \quad (ii)$$

where $R_a = r_a \sqrt{S(i_t^2)}$, $R_b = r_b \sqrt{S(i_t^2)}$, etc.

Since the right-hand sides of equations (ii) may be computed from the given index numbers, we have $\frac{n(n-1)}{2}$ equations from which to estimate the appropriate values of R_a , R_b , etc. These values may be obtained by getting approximate values of the R 's in the following manner:—Equations (ii) give

$$R_a^{n-1} R_b R_c \dots = S(x_t y_t) S(x_t z_t) \dots = P_1 \text{ (say),}$$

taking all such products as $R_a R_b$, $R_a R_c$, which contain R_a . Taking all these products into account we get

$$(R_a R_b R_c \dots)^{n-1} = S(x_t y_t) S(x_t z_t) \dots S(y_t z_t) \dots = P \text{ (say).}$$

From these we get

$$R_a = P_1^{\frac{1}{n-1}} / P^{\frac{1}{(n-1)(n-2)}}$$

and similar expressions for R_b , R_c , etc.

If we call the values thus obtained as approximations to the R 's, R_a' , R_b' , etc., and write $R_a = R_a' + \varepsilon_a$, $R_b' = R_b + \varepsilon_b$, etc., we may substitute in equations (ii) and get,

$$\varepsilon_a R_b' - \varepsilon_b R_a' = S(x_i y_i) - R_a' R_b',$$

$$\varepsilon_a R_c' - \varepsilon_c R_a' = S(x_i z_i) - R_a' R_c', \text{ etc.}$$

neglecting as small, such products as $\varepsilon_a \varepsilon_b$, $\varepsilon_a \varepsilon_c$, etc.

These equations may be used to give values of ε_a , ε_b , etc., by the method of least squares. Having thus obtained better approximations to the R 's, these new values may be used in the same equations, give still better approximations to the values of the R 's satisfy the equations (ii).

Now returning to our equations (i), we may obtain by squaring and addition these equations, which involve the same assumptions as before :—

$$S(x_i^2) = R_a^2 + S(a_i^2), S(y_i^2) = R_b^2 + S(b_i^2), \text{ etc.}$$

Using the calculated values of the R 's, we can now get approximations to $S(a_i^2)$, $S(b_i^2)$, etc.

We are now in a position to obtain approximations to the i 's. Let us consider for the moment the unknown i_t . We may regard the calculated index numbers as giving estimates of multiples of this, these estimates involving errors. Thus the index number X_t gives us an estimate, involving an error a_t , of a system of errors which we will assume is normally distributed with standard deviation s_a . Similarly, we will suppose that the error (b_t) introduced in the calculation of the second index number is one of a normal system with a standard deviation s_b , and so on.

We may therefore say that the chance of the errors a_t , b_t , c_t , etc., being introduced into the computations is proportional to

$$e^{-\frac{1}{2}(\frac{a_t^2}{s_a^2} + \frac{b_t^2}{s_b^2} + \dots)}.$$

We may say that the most likely value of i_t associated with this period of time (t) is that value of i_t which will make this chance a maximum. Using equations (i), this means finding the value of i_t which makes the expression

$$\frac{(x_t - r_a i_t)^2}{s_a^2} + \frac{(y_t - r_b i_t)^2}{s_b^2} + \dots$$

a minimum. The value of i_t , which is obtained by differentiating this expression with respect to i_t , is

$$i_t = \frac{\frac{x_t r_a}{s_a^2} + \frac{y_t r_b}{s_b^2} + \dots}{\frac{r_a^2}{s_a^2} + \frac{r_b^2}{s_b^2} + \dots}$$

Since $s_a^2 = \frac{S(a_i^2)}{m}$, $s_b^2 = \frac{S(b_i^2)}{m}$, etc., we can write this

$$\frac{i_t}{\sqrt{S(i_t^2)}} = \frac{\frac{x_t R_a}{\sqrt{S(a_i^2)}} + \frac{y_t R_b}{\sqrt{S(b_i^2)}} + \dots}{\frac{R_a^2}{\sqrt{S(a_i^2)}} + \frac{R_b^2}{\sqrt{S(b_i^2)}} + \dots}$$

Thus, using the values of the R 's already obtained from the data, and the estimated values of $S(a_i^2)$, $S(b_i^2)$, etc., we can estimate for all values of t the appropriate i 's, not absolutely, but in terms of $\sqrt{S(i_t^2)}$. Now since

$$\frac{R_a i_t}{\sqrt{S(i_t^2)}} = r_a i_t,$$

and similarly, we can find for each value of t , $r_a i_t$, $r_b i_t$, etc., and then by subtraction (from x_t , y_t , etc., respectively) we can get each value of a_t , b_t , etc. These will naturally lead us to a check on the values of $S(a_i^2)$, $S(b_i^2)$, etc., which we obtained above by calculation.

As an illustration we may take the monthly Wholesale Price Indices of (a) the Board of Trade, (b) the *Statist*, (c) the *Times* newspaper, (d) the *Economist*, for the period 1931-34. The data consist then of four sets of 48 index numbers. The Board of Trade index is the new one based on 1930, the *Statist* index is based on 1867-77, the *Times* index is based on 1913, and the *Economist* index is also based on 1913. These index numbers are referred to as X, Y, Z, U, respectively.

We obtained as a result of calculations based on the method described above, these values for the R 's:

$$R_a = 12.95, R_b = 14.12, R_c = 17.82, R_d = 19.76.$$

The following table gives a comparison between the sums $S(x_i y_i)$, $S(x_i z_i)$, etc., and the products of the R 's in pairs:—

$S(x_i y_i)$	198.83	$R_a R_b$	182.83	Difference	+ 16.00
$S(x_i z_i)$	230.63	$R_a R_c$	230.80	,,	— 0.17
$S(x_i u_i)$	244.76	$R_a R_d$	255.89	,,	— 11.13
$S(y_i z_i)$	240.28	$R_b R_c$	251.58	,,	— 11.30
$S(y_i u_i)$	278.61	$R_b R_d$	278.92	,,	— 0.31
$S(z_i u_i)$	360.19	$R_c R_d$	352.11	,,	— 8.08

From our data we obtain:

$$S(x_i^2) = 200.05, S(y_i^2) = 285.23, S(z_i^2) = 350.39, S(u_i^2) = 409.43.$$

Subtracting from these the appropriate R^2 's we get

$$S(a_i^2) = 32.32, S(b_i^2) = 85.94, S(c_i^2) = 32.80, S(d_i^2) = 19.05.$$

Using the formula for finding the i 's, and then obtaining the sums of the squares of the errors, in the manner described above we get, finally.

$$S(a_i^2) = 31.35, S(b_i^2) = 80.05, S(c_i^2) = 19.92, S(d_i^2) = 8.11.$$

From these we may obtain the standard errors of measurement, as follows :—

$$s_a = 0.81, s_b = 1.29, s_c = 0.64, s_d = 0.41.$$

If, on the other hand, we use the values of $S(a_i^2)$, etc., obtained by subtraction of the R^2 's from the $S(x_i^2)$, etc., we get

$$s_a = 0.82, s_b = 1.34, s_c = 0.83, s_d = 0.63.$$

Whichever of these sets of results we consider, we see that, judging from the data which have been used, the most precise of these indices is that of the *Economist*, the least precise is that of the *Statist*. Moreover, the degree of precision of the *Economist* number is indicated by a standard error of about 0.5. Thus, judging from our data, we may say that about twenty times out of thirty this index is correct within ± 0.5 , or we may say that the chances are all in favour of the index on any occasion being correct within limits ± 1.0 .

Further, going back to a consideration of the R 's, we see that the largest of these is R_d , that appropriate to the *Economist*. This index is then apparently the most sensitive, since it has the largest multiplier of the v 's, so that any upward or downward movement in Wholesale Prices is measured on a large scale. This is apparently due to the fact that the basis of reference is the year 1913. It will be observed that the R for the *Times* index is also large. The smallest of the R 's is that of the Board of Trade, whose index is based on 1930. Of course another way of looking at these figures R leads one to consider whether the *Economist* index is exaggerating movements up or down, but since there is no *a priori* knowledge of the absolute values of any movements of I , it is left to the individual to interpret the meaning of these multipliers.

A SAMPLE INVESTIGATION OF THE 1931 POPULATION CENSUS WITH
REFERENCE TO EARNERS AND NON-EARNERS.

By R. F. GEORGE.

(A Paper read to the Study Group, December 10th, 1935.)

1. INFORMATION as to the number of earners and non-earners and the size of families according to occupation is not given in the Census Reports. In order to gather data on this subject, a random sample was taken by the courtesy of the Registrar-General from the original 1931 Census schedules. The schedules are bound together in volumes each containing 250, and to avoid undue portorage, one bound volume in approximately every 80 feet of shelving was selected. All the private families recorded in that volume were taken for the sample. In this way, cards for 22,980 private families were punched and sorted on Hollerith machines. The particulars recorded were as follows :—

(1) Identity of schedule.

(2) Classification of each member of the family according to age :—

Under 1 year.				
1 year and under 5 years.				
5 years " " 14 "				
14	"	"	22	" Males.
14	"	"	22	" Females.
22	"	"	65	" Males.
22	"	"	65	" Females.
65 years and over.				

(3) Number of earners and non-earners.

(4) Age, sex and occupation of each earner.

The Census allowed for well over 900 occupations, which were classified for this investigation as follows :—

Unemployed,
Farm Workers,
General Labourers,
Non-manual Workers,
Others (mainly skilled manual workers).

The earners do not necessarily indicate all the family income, since there was naturally no information available as to private sources

of income or pensions. For the purpose of this enquiry, earners were defined as those for whom an occupation was given, whether unemployed or not. Domestic servants were included as earners when it appeared in the column headed "Relationship to serving Household" that they were "daily" maids, not residing at their place of employment. Otherwise they were regarded as non-earning members of the household. Lodgers, where returned on the same schedule were included with the family. In the first instance, only the chief earner has been classified by occupation.

2. Table I classifies the 22,980 families according to the number of earners and dependents. Nearly half of the families were dependent on one earner and over a quarter had two earners. On the other hand, 64 per cent. had one or two non-earners. The most common type of family consisted of one earner and one non-earner; this type was followed by "one earner—two non-earner" and "two earner—one non-earner" families. Thus over $17\frac{1}{2}$ per cent. of the families consisted of the type represented by the husband earning with the wife at home; over 12 per cent. of the husband earning with the wife and one child at home; and over $10\frac{1}{2}$ per cent. of husband and one child earning with the wife at home. These three types of family constituted over 40 per cent. of the sample. Only 8 per cent. of the families had four earners or more, and only 11 per cent. had four or more non-earners. The number of families with more than three earners and four non-earners was relatively very small.

3. Table II shows the number and proportion of total persons in the sample classified according to earners and non-earners. In the 22,980 families there were 40,418 earners and 41,193 non-earners, giving a total of 81,611 persons. The population, like the number of families, was densest around the family of two or three persons, although the proportion of families in this neighbourhood was naturally higher than that of the population. The families of one earner with one or two dependents, together with those of two earners and one dependent accounted for nearly 41 per cent. of all families, whereas they represented less than 30 per cent. of the population. Households with four earners or less represented 94 per cent. of the total persons compared with 97 per cent. of the total families.

4. From data given in the housing volume of the Population Census, certain comparisons can be made between the official figures for England and Wales and those of this investigation. It is possible to compare the percentage of private families and of the population living in private families according to size of family for the country as a whole and for the sample.

TABLE I.
NUMBER OF FAMILIES ACCORDING TO EARNERS AND DEPENDENTS.
(Also expressed as percentage of total sample.)

Percentages in italics.												
Number of Earnings.	Number of Dependents.											Total Number of Families.
	0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
0	—	596 2.6	305 1.6	120 0.6	48 0.2	15 0.1	11	3	—	1	—	1,171 5.1
1	1,052 4.6	4,067 17.7	2,818 12.3	1,007 5.0	760 3.3	312 1.3	156 0.7	59 0.3	23 0.1	6	2	10,862 47.3
2	1,086 4.7	2,490 10.8	1,343 5.8	680 3.0	314 1.1	141 0.6	55 0.2	32 0.1	8	5	1	6,155 26.8
3	368 1.6	1,185 5.2	601 2.9	334 1.4	102 0.7	85 0.1	41 0.2	16 0.1	9	1	—	2,865 12.5
4	149 0.6	510 2.2	302 1.3	118 0.6	80 0.3	38 0.2	20 0.1	11	1	—	—	1,259 5.5
5	52 0.2	196 0.9	91 0.1	75 0.3	29 0.1	18 0.1	7	2	—	—	—	471 2.0
6	14 0.1	57 0.2	39 0.2	17 0.1	7 0.1	5	—	—	—	—	—	141 0.6
7	9	11	11	3	4	2	1	—	—	—	—	41 0.2
8	—	4	1	2	—	—	—	—	—	—	—	10
9	—	2	1	—	—	—	—	—	—	—	—	3
10	—	—	1	—	1	—	—	—	—	—	—	2
Total	2,730 11.9	9,118 39.7	5,642 24.6	2,995 13.0	1,405 6.1	616 2.7	291 1.3	123 0.5	44 0.2	13 0.1	3	22,980 100.0

Percentages in italics.

TABLE II.
 NUMBER OF PERSONS ACCORDING TO FAMILIES CLASSIFIED BY EARNERS AND DEPENDENTS.
 (Also expressed as percentage of total sample.)
 Percentages in italics.

Number of Earnings.	Number of Dependents.											Total Earnings.
	0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
0	—	506 0.7	730 0.9	387 0.5	192 0.2	75 0.1	66 0.1	21	24	9	—	2,100 2.6
1	1,052 1.3	8,134 9.9	8,451 10.1	6,428 7.9	3,800 4.6	1,872 2.3	1,092 1.3	472 0.6	207 0.3	60 0.1	22	31,593 38.7
2	2,172 2.7	7,470 9.2	5,372 6.6	3,400 4.1	1,881 2.3	987 1.2	440 0.5	288 0.3	80 0.1	55 0.1	12	22,160 27.1
3	1,104 1.3	4,740 5.8	3,320 4.1	2,004 2.1	1,131 1.4	680 0.8	369 0.5	100 0.2	99 0.1	12	—	13,622 16.7
4	596 0.7	2,550 3.1	1,812 2.2	1,036 1.3	640 0.8	342 0.4	200 0.2	121 0.2	12	—	—	7,309 9.0
5	260 0.3	1,176 1.5	658 0.8	600 0.7	261 0.3	180 0.2	77 0.1	—	—	—	—	3,212 3.9
6	84 0.1	309 0.5	312 0.4	153 0.2	70 0.1	55 0.1	—	26	—	—	—	1,099 1.4
7	63 0.1	88 0.1	99 0.1	30 0.1	44 0.1	24	13	—	—	—	—	361 0.4
8	—	36	40	22	—	—	—	—	—	—	—	98 0.1
9	—	20	11	—	—	—	—	—	—	—	—	31
10	—	—	12	—	14	—	—	—	—	—	—	26
Total	5,331 6.5	25,209 30.9	20,820 25.5	14,060 17.2	8,039 9.9	4,215 5.2	2,257 2.8	1,088 1.3	422 0.5	136 0.2	34	81,611 100.0

Percentage of Private Families according to Size of Family.

No. of Persons in Family.	(a) Sample Enquiry.		(b) England and Wales. Per cent.
	No. of Families.	Per cent.	
1	1,648	7.2	6.7
2	5,518	24.0	21.9
3	5,805	25.2	24.1
4	4,332	18.8	19.4
5	2,681	11.7	12.4
6	1,483	6.5	7.3
7	770	3.3	4.1
8	407	1.8	2.1
9	196	0.9	1.1
10	84	0.4	0.5
11 and over	56	0.2	0.4
	22,980	100.0	100.0

The distributions roughly agree with each other, although the percentage of one, two and three person families in the sample was higher than for the country as a whole, whereas families of four or more persons were relatively fewer in the sample than for the country as a whole. This difference is naturally reflected in the corresponding distribution dealing with the population instead of families.

Percentage of the Population according to Size of Family.

No. of Persons in Family.	(a) Sample Enquiry.		(b) England and Wales. Per cent.
	No. of Persons.	Per cent.	
1	1,648	2.0	1.8
2	11,036	13.5	11.8
3	17,415	21.3	19.4
4	17,328	21.2	20.8
5	13,405	16.5	16.7
6	8,698	10.9	11.8
7	5,390	6.6	7.8
8	3,256	4.0	4.5
9	1,764	2.2	2.7
10	840	1.0	1.4
11 and over	631	0.8	1.3
	81,611	100.0	100.0

The above comparison of the population distribution shows a higher proportion of persons in the small families and a lower proportion of those in large families for the sample than for the known distribution for England and Wales. This divergence of the sample from the known distribution for the country is responsible for the size of the average family in the sample being lower (3.55 persons) than that for England and Wales (3.72 persons).

5. The number of dependents in the average family according to the number of earners was as follows :—

Number of Earners in the Family.	Average Number of Dependents in the Family.	Average Number of Dependents to each Earner.	Number of Families in the Sample.
0	1.8	—	1,171
1	1.9	1.90	10,862
2	1.6	0.80	6,155
3	1.8	0.60	2,865
4	1.8	0.45	1,259
5	1.8	0.36	471
6	1.8	0.30	141
7	1.8	0.26	41
8	1.8	0.22	10
9	1.3	0.14	3
10	3.0	0.30	2
Average 1.76	1.79	1.02	22,980

There was a remarkably consistent number of dependents irrespective of the number of earners in the family, so that, whatever the number earning, there was an average of rather less than two non-earners. This is reflected in the column showing the ratio of dependents to each earner, where there is a continuous decline throughout the range. In the aggregate there were 1.76 earners and 1.79 non-earners in the average family, which gives an "earner-dependent" ratio of 1 : 1.02.

The number of earners and non-earners in families ranging in size from 1 to 14 persons is shown in the following table :

Number of Persons in Family.	Number of Families.	Average Number of Earners per Family.	Average Number of Dependents per Family.	Number of Dependents to each Earner.
1	1,648	0.6	0.4	0.6
2	5,318	1.1	0.9	0.8
3	5,805	1.5	1.5	1.0
4	4,332	1.9	2.1	1.1
5	2,681	2.4	2.6	1.1
6	1,483	2.8	3.2	1.1
7	770	3.1	3.9	1.2
8	407	3.5	4.5	1.3
9	196	3.7	5.3	1.4
10	84	4.2	5.8	1.4
11	46	4.4	6.6	1.5
12	6	5.5	6.5	1.2
13	3	6.3	6.7	1.1
14	1	10.0	4.0	0.4
3.55	22,980	1.76	1.79	1.02

TABLE III.

AGE DISTRIBUTION OF THE SAMPLE POPULATION ACCORDING TO THE NUMBER OF EARNERS IN THE FAMILY.
(Also expressed as percentages.)

Percentages in italics.

Age.	Number of Earners.										Total of Sample Population.	Percentage of Total Population in England and Wales.
	0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
Under 1 year	21	827	249	74	38	16	13	35	11	3	2	1,589
1 year and under 5 years	105	3,110	981	381	176	62	16	15	4	—	77	4,856
5 years and under 11 years	239	5,109	2,911	2,075	801	355	73	16	2	1	15	11,907
11 years and under 14 years	72	276	1,123	1,627	1,060	629	179	58	2	3	77	5,150
14 years and under 22 years (Male)	6	6	6	6	6	6	6	6	6	6	6	6
22 years and under 25 years (Female)	6	6	6	6	6	6	6	6	6	6	6	6
25 years and under 32 years (Male)	6	6	6	6	6	6	6	6	6	6	6	6
32 years and under 41 years (Female)	6	6	6	6	6	6	6	6	6	6	6	6
41 years and under 48 years (Male)	6	6	6	6	6	6	6	6	6	6	6	6
48 years and under 55 years (Female)	6	6	6	6	6	6	6	6	6	6	6	6
55 years and over	6	6	6	6	6	6	6	6	6	6	6	6
Total	2,100	31,553	22,169	13,622	7,369	3,212	1,099	361	98	31	26	81,411
Number of families	1,171	10,862	6,155	2,865	1,359	471	141	11	10	3	2	22,980

It appears that the larger the family the greater is the ratio of non-earners to earners. Whereas in three-person families the population is equally divided between those at work and those at home, in families of 9, 10, and 11 persons there are about one and a half persons at home for every one at work.

6. In Table III the population recorded in the sample is classified according to age. Those households with no earners contained a much larger proportion of women between 22 and 65 years and of people over 65 years old than any other type. The number of children of school age in this group was also fairly high. The one-earner families were distinguished by their high proportion of children under 14 and reflected the type containing husband and wife with children of school age or below. In these, as well as in the two-earner families, there was a larger number of women than men between the ages 22 and 65. The absence of adolescents and the presence of a (probably) non-earning parent were particularly noticeable in the one-earner household. In the two-earner families the children were older than in the one-earner type, and, as in the case of the one-earner families, there was a fairly high proportion of elderly people who were probably not earning as such but drawing a pension or minor income of some sort. In the three-, four- and five-earner families the adolescent, the adult male and the adult female each account for roughly 25 per cent. to 30 per cent. of the population in each type of family. The increasing percentage of the boy or girl of 14-22 years of age illustrates the family growing up with the children leaving school and going out to work. That the chief earner is older in these than in the one- or two-earner families is also suggested by the diminishing proportion of aged people, and of children under school age. The almost equal proportions of adult males and females also suggest that in families of three or more earners, fewer women are the chief earner in the household, since it is not unreasonable to pair off male and female as the working husband and the dependent wife. The increased proportion of children under five years of age in families with seven or more earners represents the appearance of the third generation in the household. The last two columns of Table III show that the age distribution in the sample was very close to that of the total population. There is a slight deficiency in the sample of adolescents of both sexes, and a slight excess of aged persons and adult females.

7. Table IV sets out the number of families of varying sizes according to the number of earners for each occupational classification of the chief earner. The number of families in the six main groups were as follows :—

Number of Families.						
Sex of Head of Household.*					Per cent. of Total Sample.	
					Total.	
					Male.	Female.
No Earners ...	...	...	102	1,069	1,171	5.1
Unemployed ...	...	...	2,113	141	2,254	9.9
Farm Workers ...	...	...	872	10	882	3.8
General Labourers ...	...	...	1,222	41	1,263	5.5
Non-manual Workers ...	...	...	5,868	846	6,714	29.2
Others ...	...	...	9,557	1,139	10,696	46.5
Total ...	...	...	19,734	3,246	22,980	100.0

* *i.e.* the chief earner, except for the first group.

Families with no earners were found in the sample in larger numbers than were families of farm workers and were nearly as frequent as general labourers' families. As one would expect, the non-earner families were mainly presided over by a woman, probably a widow living on a pension or private means. The percentage of total families in each occupational group according to size of family was as follows:—

Occupation of Chief Earner.	Number of Persons in Family.														Total.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.		
	Proportion of Families in each Group.														
No Earners ...	30.3	31.2	11.0	4.1	1.3	0.9	0.3	0.3	0.1	—	—	—	—	100	
Unemployed ...	6.0	21.2	22.5	17.4	12.9	9.3	5.2	3.1	1.5	0.7	0.2	—	—	100	
Farm Workers	3.4	27.4	29.3	16.9	11.4	4.5	3.3	1.9	1.0	0.4	0.5	—	—	100	
General Labourers ...	3.3	18.2	23.0	19.8	14.8	8.5	5.3	3.0	1.2	0.4	0.4	—	0.1	100	
Non-manual Workers ...	4.8	26.3	27.4	19.7	11.3	5.5	2.6	1.2	0.6	0.1	—	—	—	100	
Others ...	4.9	22.9	25.8	20.3	12.1	7.1	3.6	1.9	0.9	0.3	0.3	—	—	100	

Half the families in the non-earner group consisted of isolated individuals, mostly women. Apart from this particular group, the distribution of the number of families according to size was very similar for each of the occupational groups. In each case the maximum proportion was found in the family of three persons, although from that maximum the numbers fell away more rapidly for the unemployed and farm workers than for the other types. This is probably explained on the grounds that in those families where the chief earner is unemployed or a farm worker, the children tend to leave home earlier than elsewhere. With regard to the unemployed; it is probable that the neighbourhood was suffering from depression and that as children became potential earners

TABLE IV.
NUMBER OF FAMILIES ACCORDING TO SIZE OF FAMILY AND NUMBER OF EARNERS,
(CLASSIFIED BY OCCUPATION OF CHIEF EARNER.
(Also expressed as percentage.)
Percentages in italics.

Number of Earners.		Size of Family.														Total.
		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	
No Earners.																
0	506	305	129	48	15	11	3	3	1							1,171
50-8		31.2	11.0	4.1	1.3	0.9	0.3	0.3	0.1							100.0
																Percentage of total sample 5.1
Unemployed.																
1	136	331	219	124	75	52	20	9	3							978
	6.0	74.7	9.7	5.5	3.1	2.3	1.3	0.1	0.1							43.1
2	—	144	240	126	70	44	22	12	3	1						663
		6.1	10.7	5.6	3.1	2.0	1.0	0.5	0.1							29.1
3	—	48	48	120	73	38	20	17	8	2						327
			2.1	5.3	3.2	1.7	0.9	0.8	0.1							11.5
4	—	—	—	23	61	41	18	17	12	4						177
				1.0	2.7	1.8	0.8	0.8	0.5	0.2						7.9
5	—	—	—	—	13	29	12	12	1	6						73
					0.6	1.3	0.5	0.5	0.3	0.3						3.2
6	—	—	—	—	—	2	14	3	2	1						25
						0.1	0.6	0.1	0.1	0.2						1.1
7	—	—	—	—	—	—	1		3	1						7
									0.1	0.1						0.3
8	—	—	—	—	—	—	—	—	2	1						3
																0.1
9	—	—	—	—	—	—	—	—	—	—						—
10	—	—	—	—	—	—	—	—	—	—						1
Total	136	475	507	393	292	206	116	70	34	18	5	1	—	—	—	2,554
	6.0	21.1	22.5	17.1	13.0	9.2	5.1	3.1	1.5	0.8	0.2					100.0
																Percentage of total sample 9.9

Number of Farms.	No. of 1 unit.															Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
Farm Workers.																
1	30	215	127	62	26	10	7	5	2						184	
	3.1	2.1	1.4	7.0	2.9	1.1	0.5	0.6	0.2						2.1	
2		26	120	41	31	9	6	0.7	1	0.1					27.3	
		2.9	1.6	5.0	3.9	1.0	0.7	0.6	0.1						3.3	
3			11	40	28	8	7	0.5	1	0.1					100	
			1.3	4.5	2.9	0.9	0.5	0.7	0.1						11.3	
4				3	15	6	3	2	5	1					35	
				0.4	1.7	0.7	0.3	0.2	0.6	0.1					1.0	
5						5	4	2		1					12	
						0.6	0.5	0.2		0.1					1.3	
6						2									6	
						0.2									0.7	
7							2	2							4	
							0.2	0.2							0.5	
Total	30	241	258	149	101	40	29	17	9	4					882	
	3.4	27.3	29.3	16.9	11.4	4.5	3.3	1.9	1.0	0.5					100.0	
															Percentage of total sample 3.8	
General Labourers.																
1	42	107	146	80	57	23	15	9	1	3					532	
	3.3	13.2	11.6	7.1	4.5	1.8	1.2	0.7	0.1	0.2					13.7	
2		63	152	60	48	21	6	6	2	1					339	
		5.0	12.0	4.7	3.8	1.7	0.5	0.5	0.2	0.1					25.5	
3			17	91	48	28	17	8	5	1					215	
			1.3	7.2	3.8	2.2	1.3	0.6	0.1	0.1					17.0	
4				10	31	16	13	8	1						86	
				0.8	2.5	1.3	1.0	0.6	0.3						6.8	
5					3	20	10	6	2						42	
					0.2	1.6	0.8	0.5	0.2						3.3	
6							6	1	1						8	
							0.5	0.1	0.1						0.6	
7															1	
															0.1	
Total	42	230	315	250	187	108	67	38	16	5					1,263	
	3.3	18.2	24.9	19.8	14.8	8.6	5.3	3.0	1.2	0.4					100.0	
															Percentage of total sample 5.5	

TABLE IV.—Continued.

Number of Family.	Size of Family.														Total.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	
Non-Manual Workers.															
1	323	1,482	990	513	219	82	40	10	8	3	1	—	—	—	3,671
	4.8	23.1	11.7	7.6	3.3	1.2	0.6	0.1	0.1	—	—	—	—	—	51.7
2	—	278	756	435	211	76	37	3	10	2	—	1	—	—	1,809
	—	4.1	11.3	6.5	3.1	1.1	0.6	—	0.1	—	—	—	—	—	26.9
3	—	—	88	336	206	80	31	19	8	4	1	—	—	—	773
	—	—	1.3	5.0	3.1	1.2	0.4	0.3	0.1	—	—	—	—	—	11.5
4	—	—	—	36	142	83	40	18	3	6	—	—	—	—	328
	—	—	—	0.6	2.1	1.2	0.6	0.3	0.1	0.1	—	—	—	—	1.9
5	—	—	—	—	15	47	15	16	9	3	—	—	—	—	105
	—	—	—	—	0.2	0.7	0.2	0.2	0.1	—	1	—	—	—	1.6
6	—	—	—	—	—	1	6	10	1	—	—	—	—	—	19
	—	—	—	—	—	—	0.1	0.1	—	—	—	—	—	—	0.3
7	—	—	—	—	—	—	1	2	—	—	1	—	—	—	3
8	—	—	—	—	—	—	—	—	1	1	1	—	—	—	3
9	—	—	—	—	—	—	—	—	—	1	—	—	—	—	2
10	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1
Total	323	1,760	1,834	1,320	793	360	170	78	40	20	5	2	—	—	6,711
	4.8	26.2	27.3	19.7	11.8	5.5	2.5	1.2	0.6	0.3					100.0
															Percentage of total sample 29.2

TABLE IV.—Continued.

Number of Families.		Size of Family.											Total.			
		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.		12.	13.	14.
Other Workers.																
1	521 4.9	1,872 17.5	1,336 12.5	819 7.7	383 3.6	145 1.3	65 0.6	26 0.2	9 0.1	—	1	—	—	—	—	5,177 48.4
2	—	575 5.1	1,222 11.1	678 6.3	317 3.0	164 1.5	70 0.7	34 0.3	16 0.1	3	4	—	—	—	—	3,083 28.8
3	—	—	201 1.9	508 4.6	311 2.9	180 1.7	87 0.8	35 0.3	19 0.2	9	6	1	—	—	—	1,450 13.6
4	—	—	—	77 0.7	261 2.1	150 1.5	74 0.7	35 0.3	11 0.1	9	6	1	—	—	—	633 5.9
5	—	—	—	—	21 0.2	95 0.9	53 0.5	39 0.1	17 0.1	8	6	—	—	—	—	239 2.2
6	—	—	—	—	—	9 0.1	31 0.3	25 0.2	13 0.1	3	—	—	2	—	—	83 0.8
7	—	—	—	—	—	—	5 0.1	7 0.1	8 0.1	2	3	1	—	—	—	26 0.2
8	—	—	—	—	—	—	—	—	1	2	1	—	—	—	—	4
9	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
Total	521 4.9	2,447 22.9	2,762 25.8	2,172 20.3	1,293 12.1	749 7.0	385 3.6	201 1.9	97 0.9	37 0.3	27 0.3	3	2	—	—	10,696 100.0
														Percentage of total sample 48.5		

they sought work elsewhere. The families whose chief earner was a general labourer tended to be more widely distributed over the larger families than the other types. The result of this is indicated in the following table, which shows the number of earners and non-earners according to the occupation of the chief earner.

Occupation of Chief Earner.	Number of Families.	Average Number of Persons per Family.		
		Earners	Non-Earners.	Total.
No Earners	1,171	—	1.79	1.79
Unemployed	2,254	2.04	1.87	3.91
Farm Workers	882	1.74	1.81	3.55
General Labourers ...	1,263	2.00	2.00	4.00
Non-manual Workers ...	6,714	1.73	1.73	3.46
Others	10,696	1.88	1.79	3.67
Total	22,980	1.76	1.79	3.55

It appears that there was a fairly consistent ratio of one earner to one non-earner in all families irrespective of occupation. There was, however, a considerably greater divergence in the size of the family as between occupations. Leaving the non-earner families out of account, the average size of family varied from less than three and a half persons for non-manual workers to four persons for general labourers. The greatest divergence from the average ratio of one earner to one non-earner occurred in the unemployed group where a younger member of the family or the wife was necessarily encouraged to become a subsidiary earner.

8. In Table V the nature of the occupation of the first male subsidiary earner is shown according to the occupation of the chief

TABLE V.

OCCUPATION OF FIRST MALE SUBSIDIARY EARNER ACCORDING
TO THE OCCUPATION OF THE CHIEF MALE EARNER.

Occupation of Chief Male Earner.	Number of Families with Male as Chief Earner and with a Male Subsidiary Earner.	Occupation of the First Male Subsidiary Earner.				
		Un- employed.	Farm Workers.	General Labourers.	Non- manual Workers.	Others.
Unemployed	393	124	17	55	75	322
Farm Workers	290	19	100	17	97	57
General Labourers ...	437	66	22	79	48	222
Non-manual Workers ...	1,550	104	62	38	685	661
Others	2,926	355	79	190	455	1,849
Total	5,798	668	280	379	1,360	3,111

male earner, in order to gain some idea of the extent to which the eldest son, when going out to work, follows the occupation of his father. It is realized that not every chief male earner in this Table will necessarily be the father of the appropriate first male subsidiary earner. In the great majority of cases, however, this will be so and the exceptions are not sufficiently numerous, it is thought, to invalidate the following conclusions. Where the father was unemployed, 20 per cent. of the eldest sons above school age were also unemployed, whereas well over 50 per cent. were working in a skilled manual occupation. But it is noticeable that the proportion of the first male subsidiary earners who were unemployed was very much larger when the father was unemployed than otherwise. In the total, less than 12 per cent. of the eldest boys were unemployed compared with 20 per cent. where the father was also out of work. Farm workers' sons appeared to find work to an equal extent on the farm and in non-manual employment. The sons of general labourers showed a very marked tendency to follow a skilled occupation and thus to improve upon the economic and social status of the parent. The non-manual workers' and the skilled manual workers' sons tended to a greater extent than those of any other group to follow the parents' occupations. In general, this classification, although it refers to only 5,798 families, does indicate the boys' attempt to find work in an occupation of a more skilled type than that of the father, and if the latter is already a skilled worker that the boy tends to maintain his father's economic status.

In conclusion, I would like to express my indebtedness to Mr. Colin Clark for his assistance in the early stages of the enquiry, and to Mr. V. P. Derrick and Mr. R. G. D. Allen for the suggestions they kindly made in the discussion at the Study Group meeting.

THE ENUMERATION OF POPULATION AT THE MEETINGS OF THE SOCIETY.

By A. BRADFORD HILL, D.Sc.

It has been said, somewhat irreverently, that an experienced Fellow of the Society coming late to one of its meetings could determine precisely the subject-matter of the paper read by the attendance thereat. If he should experience difficulty in finding a comfortable seat there is no doubt whatever, according to the members of this school, that the intricacies of finance are under discussion; if, on the other hand, he observes a somewhat sparsely filled hall it is more than likely that the statistics at issue are those of life and death; while if he is faced with an embarrassingly empty room it is certain that the exponent of mathematical methods is at the reader's desk. Gleaning in the Society's records is likely to be an unprofitable pastime after the labours of Mr. Macrosty in compiling, in the Centenary year, his delightful and comprehensive *Annals of the Society*. But on this subject of attendance at meetings the *Annals* are, perhaps discreetly, silent. It, therefore, appeared that a few idle hours might be pleasantly spent in applying a statistical test to the assertions of the irreverent, and that the figures so acquired might in other respects be of some slight interest to Fellows of the Society.

The numbers signing the attendance registers were extracted, discriminating between Fellows and Visitors, for the years 1912 to 1934 inclusive. It is pleasant to find, as is shown in Table I, that

TABLE I.
Average Attendance at the Society's Meetings.

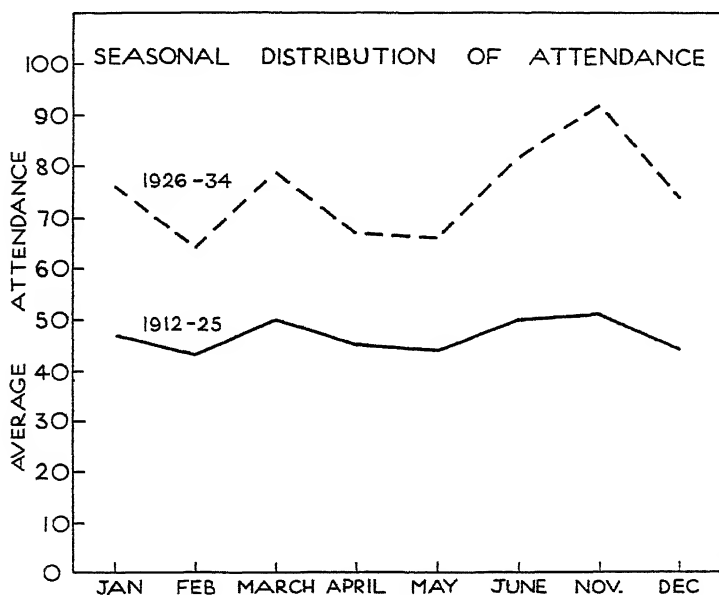
Calendar Years.	Average Number Present.		
	Fellows.	Visitors.	Total.
1912-14	28	16	44
1915-18	24	20	44
1919-22	29	18	47
1923-26	37	19	56
1927-30	46	28	74
1931-34 *	50	28	78

* Excluding centenary meeting.

in recent years there has been an appreciable increase in the number of persons present at the Society's meetings. The average number

pre-ent in 1912-14 was 44, while in 1931-34 it was 78. According to the Annual, the number of Fellows was 846 at the end of 1913, and 1024 at the end of 1933. While the population had risen by 21 per cent. the average attendance had increased by 77 per cent.

The increase in attendance applies equally to Fellows and visitors, the former showing a rise of 79 per cent., the latter of 75 per cent., so that the ratio of Fellows to visitors remains the same to-day as in 1912-14 at one-and-three-quarter Fellows to one visitor (though some minor fluctuations are apparent in the intervening years). The annual figures show a steady rise from 1925, with an average of 50, to 1931, when the maximum of 90 was reached;



but this peak has not been maintained, the averages for 1932, 1933 and 1934 being 77, 73 and 71.

If it is desired to relate the average attendance to the number of Fellows in the Society, it must be remembered that a great number of Fellows are unable to take an active part in the Society's meetings by reason of their geographical location. A scrutiny of the addresses in the Society's annual list (1934) shows approximately 530 Fellows resident in London and the Home Counties, 210 in the more distant counties, 53 in Scotland, Wales and Ireland, and some 190 abroad. Roughly 500 may therefore be taken as the number of Fellows to whom attendance at meetings is possible and with the average attendance of Fellows (excluding visitors) at present at about 50

it follows that some 10 per cent. attend on the average any one meeting.

As Lord Meston wrote in his preface to the *Annals*, no national boundaries confine the work of our Society, and it is of interest to observe how geographically widespread is the Fellowship. From the addresses given in the annual list it appears that in 1934 nearly one-fifth of the ordinary Fellows were resident abroad and in the following countries :—

- 54 in India.
- 52 in Canada and the U.S.A.
- 15 in S. Africa.
- 14 in Australia and New Zealand.
- 8 in Egypt.
- 7 in The Straits Settlements.
- 5 in S. America.
- 4 in Switzerland.
- 3 each in France, China and E. Africa.
- 2 each in Spain, Poland, Denmark, Persia, Italy and Palestine.
- 1 each in Serbia, Hungary, Czechoslovakia, Greece, Sweden, Holland, Esthonia, Morocco, Jamaica and the Hawaiian Islands.

Returning to the statistics of attendance at meetings, further analysis is made for two secular periods, 1912–25 and 1926–34, the annual averages being approximately constant over the earlier period and at an appreciably higher level over the latter. In both periods the seasonal trend is remarkably similar, as may be seen in the diagram. The minimum falls in February, but this feature cannot necessarily be ascribed to the inclemency of the climate, since the figure differs immaterially from those recorded in April and May. The most striking characteristic of recent years is the enthusiasm for Presidential Addresses, as evinced by the November peak. In the years 1926–34 the average attendance at 63 Ordinary meetings was 73 Fellows and visitors; at 7 Presidential Addresses it reached 101, an excess of nearly 40 per cent. at the latter. In 1912–25 the average number at 98 Ordinary meetings was 46 and at 10 Presidential Addresses 57, an excess of only 24 per cent. at the latter.

Table II gives the frequency distributions of the numbers attending all the meetings in the years 1912 to 1934.

Comparison of the constants for these two periods shows an increase of 62 per cent. in the average attendance, and 52 per cent. in the modal value. The absolute variability is considerably greater in recent years, but relatively, as shown by the coefficient of variation, there has been no appreciable change.

TABLE II.

Number Present (Fellows and Visitors).	Number of meetings at which given number present was recorded (including Presidential Addresses).	
	1912-25.	1926-34.
20-	6	1
30-	35	2
40-	23	5
50-	25	9
60-	11	16
70-	7	9
80-	—	8
90-	1	8
100-	—	5
110-	—	4
120-130	—	3
Total	108	70
Arithmetic mean	47	76
Mode*	42	64
Standard Deviation	13.9	23.2
Coefficient of Variation	29.6	30.5

* From the formula $\text{Mode} = \text{Mean} - 3 (\text{Mean} - \text{Median})$.

It is obvious that the attraction of the Presidential Address referred to above may lie in the distinction of our Presidents, as well as in the subject-matter they choose to expound. Therefore in approaching the problem propounded at the beginning of these notes—the “drawing-power” of different branches of statistics—it appears wise to exclude Presidential Addresses from the analysis. In making this analysis of subject-matter I have followed the classification of papers given by Mr. Macrosty in the *Annals*. The results are shown in Table III.

In recent years the figures show that there is no doubt of the attraction of papers devoted to the statistics of prices, commerce and finance, the average attendance at these meetings exceeding 80. There is equally no doubt of the smaller following of vital statistics the average attendance, 61 in 1926-34, being the lowest but one on the list in those years and the lowest of all in 1912-25. The average attendance of 74 at papers devoted to the methods and collection of statistics—under which heading the few mathematical papers are placed—certainly affords no grounds for complaint. Within each of these groups there is, however, very considerable variability round the averages. If one takes together papers (1926-34) on prices, commerce and finance, the average attendance at 21 papers is 86 with a standard deviation of 20.9; for 16 papers

TABLE III.

Classification of Papers.	Average attendance at meetings (excluding Presidential Addresses).	
	1926-34.	1912-25.
Prices	88 (5) *	52 (3)
Commercial	87 (10)	44 (6)
Financial	81 (6)	55 (13)
Transport	78 (3)	59 (5)
Collection and Methods	74 (6)	44 (7)
Moral, Social and Political	67 (6)	41 (8)
Production, Consumption, Wealth and Income	67 (11)	50 (14)
Agricultural	63 (2)	44 (5)
Vital	61 (9)	39 (25)
Labour	56 (5)	46 (8)
Miscellaneous	—	41 (4)

* Number of papers in brackets.

on agriculture, labour, and vital statistics the average is 59 with a standard deviation of 17.4. The difference is (by the "t" test) more than is likely to arise by chance. On the other hand, if one applies the analysis of variance to all the categories of Table III (1926-34 meetings), the variability between groups is considerably higher than that within groups, but not in the formal sense significantly so. The problem is no doubt complicated by the attraction of individual readers of papers as well as by their subject-matter, but I have sufficient restraint to refrain from investigating that factor.

Increased attendance between 1912-25 and 1926-34 is apparent in all categories. Taking three broad groups from Table III, the increases in average attendance are :—

Prices, Commercial, Financial, Transport 60 per cent.

Collection and Methods, Moral, Social and Political.

Production, Consumption, Wealth and Income 49 per cent.

Agricultural, Vital and Labour 45 per cent.

There has been a somewhat larger increase in the average attendance at meetings devoted to questions of finance, prices and commerce, so that the comparatively greater interest taken in these subjects is in part a modern, and perhaps cyclical, phenomenon. The vital statistician will confidently rely on the present period of the Presidency to correct the balance.

REVIEWS OF STATISTICAL AND ECONOMIC BOOKS.

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1.—*Einführung in die Mathematische Statistik.* Von Prof. Oskar N. Anderson. Wien: Julius Springer, 1935. 9½" × 6". 314 pp. Rm. 22 (gehsunden Rm. 23.60).

The reviewer accepted the responsibility of noticing Prof. Anderson's book for the following reasons. Anybody who has been in active statistical practice for thirty years knows that the whole subject of statistical methodology has undergone a transformation. It is, of course, true that, even thirty years ago, a student who was fortunate enough to have not only a natural aptitude for mathematical reasoning but a thorough mathematical training, enjoyed a great advantage over his colleagues. It is equally true that a large majority of even professedly mathematical-statistical papers could be understood by readers whose formal mathematical acquirements were modest. That has long ceased to be true. Those of us whose mathematics are confined to a fair knowledge of school-boy algebra and an elementary knowledge of analysis—say knowledge at about the level of the "pass" mathematics of a London B.A.—and are old enough to be able to exercise some power of self-judgment, are aware that only a minority of recent methodological papers can be intelligently criticized or even understood by us.

Therefore, when a distinguished contributor to the methodology of modern statistics publishes a book explicitly addressed to persons of this class, it is proper that one of them should review it. There is a risk that he will fail to detect technical errors, but his judgment on the question of intelligibility should be more valuable than that of an expert.

The only advantage the present reviewer can claim to have over the public to which the book is addressed, is a certain familiarity with the more elementary writings of the late Prof. Tschuprow, and most readers of the *Journal* of our Society should be familiar with some of Prof. Tschuprow's work.

In this Introduction Prof. Anderson begins by carefully explaining the idea of a statistical "universe" or "population" (*Gesamtheit*), and then, after summarizing conflicting opinions on the definition of probability, accepts, as not philosophically ideal but sufficient for his purpose, a statistical definition, viz. "That the probability of a characteristic within the field of a statistical universe is its frequency within a universe of higher order from which the given universe has been derived. For the practical application of the theory of probability, the method of derivation must be accurately defined."

Prof. Anderson subdivides the field of application of mathematical-statistical methods into six parts:

(1) The study of averages or statistical parameters appropriate for the description of a universe.

(2) The doctrine of direct inference from knowledge of the statistical parameters of a universe respecting the average characteristics of a universe of lower order, *i.e.* inference from population to sample.

(3) The doctrine of inferences from the characteristics of a universe of lower order respecting the characteristics of a universe of higher order, *i.e.* inferences from sample to population.

(4) The study of stability in time and space of universes of higher order and their statistical parameters.

(5) The theory of investigation of universes which are unstable in time or space.

(6) The theory of statistical methods intended to establish relations of cause and effect between elements of different universes.

From the nature of the book, Parts (1)–(3) receive fuller treatment than the others.

The first chapter is devoted to homograde statistics, or, as we should say, statistics of attributes. The first part of the chapter follows well-worn lines, as is inevitable, but when we reach p. 77, "The Principle of Large Numbers," the discussion is more stimulating than what one usually finds in books intended for beginners. The reviewer is not quite sure whether the reader will easily distinguish what may be called the theoretical and practical problems. If a sample of size n is drawn from a universe of N in which the relative frequency of a character is M/N and we imagine a universe defined as the aggregate of all possible sets of n , viz. $\frac{(N)!}{(N-n)!}$ such sets,

then a determination of the frequency distribution of sets containing 0, 1, 2 . . . n individuals possessing the character is a mere problem of enumeration. But whether the elements of any particular universe of N from which samples of n are drawn "at random" are well mixed, equally accessible—or whatever phrase we prefer—is a matter of objective, and sometimes unascertainable, fact. Prof. Anderson thinks that for practical purposes we may rest content with the axiom that when we do draw from a well-mixed universe it will rarely happen that we draw an element the relative frequency of which in the universe is small. He emphasizes the point that by randomness we always mean randomness with respect to the attribute under examination. If numbered tickets are printed in different colours and there is no correlation between the colour of a ticket and the number printed on it, then it would not matter, if we are interested in numbers only, whether the tickets were or were not arranged in colour zones.

Prof. Anderson, who is certainly as fond as most writers of computing astronomical improbabilities, carefully avoids the error of attaching absolute importance to such sums. He points out that one cheerfully faces the risk of a one in five unfavourable chance when the unfavourable event is no more than a wetting; but regards with very different feelings a one in five chance of dying in an illness.

Prof. Anderson, after an introductory account of "Goodness of Fit," which is continued in a later chapter, devotes some pages to the vexed question of Bayes' problem, viz. inference from sample to population. He thinks that Bayes' problem as usually posed is unreal and that the really practical problem is that of defining the limits of the statistical parameters of a *single* universe of size N (where N may or may not tend to infinity) from which a sample of n presenting certain characteristics has been drawn. His discussion of this problem is admirably clear, and its relation to Prof. R. A. Fisher's treatment of the general principle is made plain. In these days of intense nationalism, it is perhaps well to note that, throughout the book, the work of English statisticians in general and of Prof. R. A. Fisher and Prof. Karl Pearson in particular, is treated with respect not seldom rising to enthusiasm. The chapter ends with an account of Poisson's limit to the binomial.

Chapter II is devoted to general heterograde theory or, as we should say, the statistics of variables. The first forty pages offer no special novelty to the English reader; the next eighteen pages describe the method of mathematical expectation. It has never seemed to the reviewer that there is a difference of *principle* between this method and those customary in English books, but a difference of *notation*. But, if this be true, it in no way detracts from the importance of mastering the notation, which, as anyone can satisfy himself, is excellent. Prof. Anderson then discusses briefly Markoff's inequalities, and this will be a convenient point to note that the fundamental distinction between the treatment in this book and that of most English books is that it is in precisising the limits of inequalities that Prof. Anderson seeks to make plain how safely

we can draw inferences from universe to sample or from sample to universe. This point of view will not be strange to readers of the *Journal* who have followed Dr. Isserlis's work. It will be found, at least by those with no more skill than the reviewer's, that the combination or inversion of inequalities requires a close attention.

The next and perhaps most important chapter is an application of principles to the problems of relationship between the parameters of sample and of universe. It is, in fact, an elementary survey of the whole theory of sampling from the point of view of a pupil of Tschuprow. The reader who wishes to master it must (unless he is a mathematical adept) take the trouble to work out a good many examples for himself. He would find it helpful to read first a popular book by a great mathematician, *An Introduction to Combinatory Analysis*, by the late Major P. A. Macmahon. The difficulties to be mastered are not mathematical technicalities of an "advanced" character, but the acquirement of some skill in manipulating complicated expressions and seeing how to reduce them. Unless this work has been done, the important section on the inversion of Markoff's inequalities will not be understood.

The fourth chapter, on correlation, the representative method and the investigation of stability in space and time, suffers from compression. As, however, Prof. Tschuprow's little book on correlation is available, the author was clearly wise to devote more of his available space to subjects the literature of which needed simplification. Prof. Anderson's use of foreign literature is so judicious that it might have been worth while for him to point out the relation between the result on p. 284 and the work of Cobb and Spearman on the "correction" of coefficients of correlation.

The general conclusion reached by the reviewer is that Prof. Anderson has well performed the task he set himself. This is a thoroughly readable book. It is a *difficult* book, because the subject is difficult; but anybody who gives it up cannot solace his pride by saying to himself that the use of advanced mathematical methods which he has never studied prevent him from reading it. The author has faithfully kept his promise to use only elementary methods. It is now possible to get the hang of modern mathematical-statistical theory without being a mathematician.

It is hardly necessary to add that the reviewer does not suggest that the closest study of this book will enable the ordinary reader to enter into competition with Prof. R. A. Fisher or with Prof. Anderson himself in methodological research. What is suggested is that a serious study of this book would dispel that cloud of mystery to which reference was made at the beginning of the review; it would also enable intelligent persons to solve for themselves some of the simpler problems of sampling theory which arise in ordinary statistical practice. For these reasons, Prof. Anderson deserves the gratitude of all statisticians. In these days of economic nationalism and high prices, it is too much to hope for an English translation at a price within the reach of most students. But it may be noted that Prof. Anderson's German is so clear that a very elementary knowledge of the language will be sufficient.

M. G.

2.—*La Théorie des Probabilités*. By P. Van Deuren. Namur: Editions Wesmael-Charlier. 1935. 10" x 7". xvii + 546 pp. 100 francs.

This book represents the fruit of thirty years' lecturing on probability by the author at the Belgian Military Academy. The two most noteworthy things about the book are the orderliness of the development and the originality of the method of treatment. Except for one or two points in the appendices, the book can be read with no previous knowledge of probability and without reference to any other book on the subject.

Probability is stated to be an intuitive idea, and it is assumed at once that probabilities can be measured by numbers, that all certain events have the same probability, which is not exceeded by any other probability, with a corresponding proviso for impossible events, and that the principle of the sum holds. From these all the usual formulæ are rigorously derived in Section I and, for frequency distributions, in Section II, the distinction being made between probabilities *a priori* and *a posteriori*. The approach is thus similar to that given by Jeffreys in his *Scientific Inference*.

The remainder of the book is almost entirely concerned with the uses and properties of the mean and the quadratic moment about the mean of a frequency distribution, and of the effects on these of transformations of the variables. Two ideas occur prominently—that of practical certainty (*certitude pratique*), which is introduced on the admission that it can rarely be said that an event is quite certain, and that of concentration, which is defined as the variance divided by the square of the range. The analysis seldom goes very deep, however, and since the only weapons used are the first and second moments, the results apply as a rule only to error curves which can be regarded as approximately normal. There is an interesting derivation of the method of least squares by means of the formulæ for probabilities *a posteriori*.

The book is liberally provided with examples, in which the classical problems in probability are very shrewdly discussed and most of the common frequency distributions appear. There are also two interesting appendices. In the first, van Deuren discusses the question: Can rigorous inductions be made when the probabilities *a priori* are known only roughly, or not at all?—a problem which has received some discussion of late in the English literature. He is careful to point out the inconsistencies which arise from assigning an arbitrary form to the unknown frequency distribution, and comes to the usual conclusion of those who take account of the *a priori* probability, namely, that in many cases the form of the frequency distribution little affects the final results. In the second appendix he answers some of the criticisms which have been made by French writers, notably J. Bertrand and H. Poincaré, of the objective value of the calculus of probabilities.

The chief criticism of the work is that as a text-book it is too self-contained and does not stimulate the student to read other works. The author gives no indication of acquaintance with writers on probability outside the French school; in particular

his statement (p. x) that the covariance (*l'écart rectangulaire*) is a new concept is somewhat surprising. A volume devoted to practical applications of the results in this book has been planned and will be of interest.

W. G. C.

3.—*Statistique et Applications*. By Georges Darmois. Paris: Armand Colin, 1934. 7⁸ x 4³". 200 pp. 10 fr. 50 c.

This small work is intended to give a bird's-eye view of the field of application which exists for modern statistics. After preliminary chapters dealing in general with the type of problem which is amenable to statistical study, the kind of ideas involved, and the method of their utilization, follow a number of short but well-written studies on such questions as the elements of population analysis, indices of economic activity and the laws of Mendelian heredity. The universality of the author's treatment of the subject is shown by his reference to the following examples, among others, of the existence of statistical law:—games of chance, proportion of male births, birth-, death- and marriage-rates, and the rate of disintegration of radioactive matter. We note, however, that the recent interesting work of W. A. Shewhart and E. S. Pearson on the statistical control of quality in manufacture is not mentioned.

Without delving deeply into problems of mathematical statistics—an objective which is definitely rejected by the author in this work—we are introduced to the methods by which statistical science brings order into the chaotic world of empirical description. The familiar averages and methods of dispersion are described, the relationship of the theory of probability to statistics is established, and the ideas of a random variable and mathematical expectation naturally follow.

The author next proceeds to show how statisticians, by not setting their aims too high, have been able to contribute to the understanding of questions of the greatest practical importance. As he says in the preface, "Demographic and economic statistical studies are representative of a field in which theory has not greatly advanced: not because mathematical methods have penetrated to insufficient depth in these cases, but because the causes of the development of the population of a country, or of its economic evolution, are not well known. The description of these phenomena has, however, made great progress and permits better statement of the problems involved. This is an important rôle of statistics." The chapter on population is the best and the fullest in the book, and while special attention is paid to the movement of French population, and the authorities quoted are principally of that nationality, the demographic statistics of the other main European countries are carefully examined and a brief section is devoted to the growth of world population. The account of indices of economic activity which follows is purely of local interest, the index numbers studied being those of the *Statist que générale de la France*. In a later chapter devoted to statistical series ordered in time the author, however, redeems this lapse into splendid isolation with an excellent account of the correlation between series of events; a searching

analysis of the logical problems involved is illustrated with the results obtained by Hooker and R. A. Fisher in this field.

As an example of the existence of statistical regularities in their purest form, the laws of Mendelian heredity receive considerable attention, and reference is made to the later work of Morgan, Bateson and Punnett. The inheritance of characteristics again receives treatment as an example of the application of the method of correlation to elucidate relationships; correlation in psychology is not forgotten, and special attention is paid to Spearman's hierarchic theory of the abilities of man. The final item in this series of studies is an interesting chapter devoted to correlation in astronomical statistics.

Where so much value is given for so little expenditure of time and money on the part of the reader, it would seem unkind to criticize adversely. It is with a book as with the State: so long as some plan of structure exists, results must follow; the plan to be pursued is, however, largely dependent on personal taste and the type of results required. While M. Darmon is able to avoid detailed mathematical investigations by referring the reader to his larger work on mathematical statistics where necessary, this involves no serious difficulty because the theorems concerned are generally well known to statisticians. The exposition in "*Statistique mathématique*" is, moreover, of that clear nature which we habitually associate with the French analysts, and this volume would well repay study by those interested in the rigorous treatment of our subject. On the other hand, we are not sure whether the author in his present book, by interspersing the above-mentioned monographs on some outstanding applications of statistics with more theoretical chapters devoted to distributions of one variable and stochastical relationships existing between several variables, has kept to what appears to be the natural and consistent plan of the work. *A chacun son goût.*

H. J. B.

4.—*Elementary Statistics for Indian Students* (Volume 1). By D. S. Dubey, M.A., LL.B., and S. L. Agrawal, M.A., B.Sc. Allahabad: The Indian Press Ltd., 1934. 8½" x 5", xii + 336 + 19 + iv pp. Rs. 6.

This text-book, Professor Thompson indicates in the foreword, is specially directed to those students who have no knowledge of the subject and find that the recommended text-books assume a familiarity with the fundamental elements which the student in fact does not possess. In any case, the first word of the title is amply justified.

The opening chapters are naturally concerned with the nature and limitations of statistics and with the collection and classification of statistical data. A discussion of the various forms of statistical averages follows. An average is defined as "a significant single expression representing the whole series," but since the same average can apply to many widely differing series, the significance is surely relative. An expression *significantly* representing a whole series must contain other elements as well as the average.

Index numbers are given two chapters, and reference may here be made to the many mis-prints in the book. In one paragraph, for example, on p. 143, we find "... the Index Number of Saurbecks ..." and a few lines later "... more that one quotations for ...". In describing some well-known index numbers, no reference is made to the U.K. Cost of Living index.

The treatment accorded to the diagrammatic representation of facts is certainly elementary. Pictures of different-sized boats indicate varying volumes of imports, and a reduction in purchasing power between 1913 and 1920 is illustrated by two pictures, one of a man holding a basket of something against his forehead, and the other of two men holding between them a basket containing rather more of, apparently, the same commodity. Diagram 31 consists of a full-page photograph of graph paper (on logarithmic scale) with the curve of the population of India drawn at the foot, so that two-thirds of the picture seems unnecessary. Measures of dispersion, correlation, interpolation, and forecasting complete the volume. These subjects are treated entirely without mathematics, the arguments and the processes being illustrated on a purely arithmetical basis. The student, however, should certainly gather an idea of what to do with the data in given circumstances even if he does not fully appreciate the reasons why.

Each chapter concludes with a summary of its content and with a set of questions on the matter discussed. The book is not designed for the average student, but it will be appreciated by those who find the usual text-books of elementary statistics somewhat difficult to follow.

R. F. G.

5.—*Studies of Differential Fertility in Sweden*. By Karl Arvid Edin and Edward P. Hutchinson. London: P. S. King & Son. 1935. $8\frac{1}{4} \times 5\frac{1}{4}$ ". 116 pp. 7s. 6d.

Folketellingen i Norge (Census of December 1st, 1930. Fertility of Marriages). Oslo: 1935. $9\frac{3}{4} \times 6\frac{1}{2}$ ". 54 + 107 pp.

Some of Mr. Edin's studies of conjugal fertility in Sweden have appeared in the *Eugenics Review* and in reports of international conferences on population problems. The outstanding feature of those contained in the brochure now issued is the evidence that, so far as Stockholm is concerned, birth control has had more marked effects on the fertility of families in the industrial operative class than among other classes in that city. Among those engaged in trade and commerce and in the liberal professions, and also among the clerical and managing staffs of industrial undertakings, the size of families is shown to have increased with the income of the husband and with his educational advance. In rural districts near the capital, and in Sweden as a whole, the reduction of births has, as in other countries, affected the classes with the smallest financial resources and the lower standards of education in a less degree than other classes.

A feature of special interest in the Swedish study is the use of a procedure, available as a result of the system of registration of the population in use in that country, that permits of tracing, without

insuperable difficulties, the history of each family. The period the births of which have been studied covered primarily the years 1919-1922, and the incomes of 1920 served as the basis of classification according to financial resources. The study was extended to cover, for the intercensal period 1920-1930, families resident in Stockholm at each of the two censuses. These additional data supported the deductions from the record of the years immediately following the World War.

The Norwegian Census Report presents a different type of material, the tabulations showing for each married woman recorded in the Census (except a small number who furnished insufficient particulars) not over 45 years of age, the year of marriage and the number of children, whether surviving or not. The wife's age at marriage is also an element in some important tables. A brief summary of results, in English, is added to the full report in Norwegian, and will assist students, as will the fact that table headings are given throughout in both languages. Comparisons with similar records from the Census of 1920 afford interesting material for study, qualified, though not very seriously, by the possible inclusion of some still-births in the 1920 records, owing to the form of the instruction on that occasion. During 1901-20, still-births were rather less than 1 to each 40 live births. Thus such a comparison as that of the average number of births to the marriages of a selected number of years earlier may be little affected. If a twenty-year interval is taken, the 1930 census shows, for surviving parents, an average of 4.17 children born, while at the 1920 census the average was 4.94. Separate figures are given for urban and rural aggregates and, in summary form, for a number of subdivisions of the country, including Oslo.

For 1930 particulars of marriages classified by the number of children born to them, and the year of the marriage, are given in each of fifteen groups for the wife's age at marriage, from 16-17 to 44-45. A feature that may be noted is that wives married at 22-23 were more numerous than those of any other group, and their total of children born was greater, though the average number of births (to the date of the Census) was greater for lower ages of marriage, and less for higher.

An analysis of the data relating to Greater Oslo gives, among other particulars, a seven-fold grouping according to the income of the husband in 1930, with particulars of numbers of families and of children, for the marriages of the census year and for those of each of the preceding ten years. A further analysis of these figures shows three sub-groups relating to persons working on their own account, to professional occupations and public administration, and to other employed persons. In the latter sub-group the fertility is found to decrease progressively with increasing income, while for all three sub-groups together, after decreasing for a time, an upward tendency is shown in the higher income ranges. The numbers appear to be too small to yield clear results for the two other sub-groups, but the presence in Oslo of the kind of influence shown in the Stockholm data gathered by Mr. Edin seems to be indicated. An

analysis of occupational effects is also given for the country at large, fourteen different occupational groups being distinguished. Students will find much of interest in these tabulations.

The great concern felt in Sweden and Norway, and also in Denmark, at the marked and increasing restriction in marital fertility as compared with a not very distant past has been shown by the recent appointment of commissions of enquiry in all three countries. It may be noted that Sweden is the only one of the three in which the reduction of marital fertility during the present century has approached closely the experience of England and Wales. Comparisons are, however, somewhat difficult owing to the notably higher rate of illegitimate births in Sweden than in England.

A. W. F.

6.—*The Social Survey of Merseyside*. The School of Social Sciences and Administration, University of Liverpool. Edited by D. Caradog Jones. University Press of Liverpool; London: Hodder and Stoughton, 1934. 8 $\frac{3}{4}$ " x 5 $\frac{1}{2}$ ". Three volumes; pp. 327, 413 and 558. 45s.

The Social Survey of Merseyside, conducted under the direction of Mr. D. Caradog Jones, is a classic piece of work, and is well worthy of its place amongst the famous social surveys of the last forty years. A generous grant from the Rockefeller Foundation and a contribution from the University of Liverpool made possible this intimate record of the social conditions of the Merseyside as they were between the midsummers of 1929 and 1932. The main objective of the enquiry was to measure the extent and to examine the nature of the social problems of present-day Merseyside, in order that future measures of social reform could be based on knowledge rather than imaginative estimates. More attention was therefore directed to the poor and to the unemployed than to those who were better off and in work. The most important source of information was a household census in which data relating to nearly 7,000 working-class families were collected. The area surveyed consisted of that part of Merseyside which is included in the four County Boroughs of Liverpool, Bootle, Birkenhead and Wallasey, and in the Urban Districts of Waterloo with Seaforth, Litherland, Great Crosby, Little Crosby, Bebington and Bromborough. The population of this area has increased from less than a quarter of a million a century ago, to over a million and a quarter to-day.

The physical character of the Merseyside and its history since mediæval times are briefly discussed, after which the general aspects of the present-day Merseyside are more particularly described. The four factors affecting the trend of population of Liverpool—extension of the city boundary, births, deaths and migration—are examined in detail for the last fifty years. The analysis of the immigrant and emigrant populations is especially complete; when comparing the Chinese and Negro populations, it is stated that the Chinese make excellent husbands, and there is little evidence of their families falling into poverty, but the same cannot be said of the Negroes and their families. A comparison of the age distribution of the Mersey-

side population with that of England and Wales suggests that the former contains a larger proportion of young persons than the latter. This difference was more pronounced in the household sample, which was restricted to working-class families, in which a larger proportion of children may be expected, partly because the proportion of married adults is higher among the workers than in other classes.

The appalling housing conditions in the centre of Liverpool are indicated by the fact that of the nine houses discovered in the household sample to contain 6 or more families, no less than five were in St. Anne's Ward. According to the criterion adopted, 30 per cent. of the tenements in this ward were overcrowded, compared with rather less than 11 per cent. in the Merseyside as a whole. Of the working-class families covered by the household sample in Liverpool, 28 per cent. have the use of a bath, 90 per cent. the use of a garden and 13 per cent. the use of both. The median rent of 4,000 houses let as a whole in Liverpool was 10s. 4d., while the median rent charged for houses let in parts was 6s. 2½d. Rent is discussed in relation to the accommodation it provides, by whom (*i.e.* principal or sub-tenant) it is paid, and whether for rent restricted or unrestricted premises. The amount and adequacy of the family income are discussed in Chapter 7, where the determination of the "poverty line" is described. In this calculation a weekly food expenditure of 6s. 3d. has been allowed for an adult male. For Liverpool, the poverty line of a family of man, wife and one infant, was calculated at 27s. 7d. per week, compared with 28s. allowed for unemployment benefit and 22s. for the Liverpool scale of Public Assistance. For a man, wife, one infant and two schoolchildren both unemployment benefit (32s.) and Public Assistance (29s.) fell very short of the calculated poverty line (37s. 7d.). Of the 6,780 families in Merseyside whose incomes were recorded, 16 per cent. were below the poverty standard, and when Public Assistance was included the proportion was only reduced to 14 per cent. The median income of families in Liverpool was approximately twice that necessary for minimum needs. Even if all the families had been enjoying "full-time" incomes, nearly 10 per cent. would still have been sub-standard. The chief factor in establishing a family well above the poverty line is that the family should have one adult male earner in regular work with or without subsidiary earners. The families below the poverty line were very largely those with no earners at all and those whose chief earner was unemployed. Poverty in relation to overcrowding and overcrowding without poverty are discussed in detail, and the lodger in working-class families is separately considered in Chapter 10. Perhaps the most important part of the first volume consists of Chapter 12, where the results of 332 working-class budgets are given. Working-class expenditure is discussed amongst other things with particular reference to food, the various items of the family's larder being analysed in detail. Table VII compares the results of the Liverpool budgets with the figures used by the Ministry of Labour, and brings out a slight difference between the two in respect of food and rent. The detailed tables of expenditure on food are based on the "equivalent adult male," but this basis

may be open to criticism in so far as the same unit standards cannot be appropriately applied to each separate commodity. The usual standard equivalents may well apply to meat and bread, but probably not to certain classes of dairy produce or sugar and jams.

The first volume concludes with a discussion of municipal housing in Liverpool, the tenants of corporation houses and regional development of the City.

The industrial aspects of the Merseyside are examined in Volume 2. A comparison of the workers employed in the Merseyside with those for the country emphasizes the commercial character of the area surveyed. Nearly half of the workers of the Merseyside are engaged in shipping, transport and distribution, whereas slightly more than a quarter of the workers in the United Kingdom are so occupied. Unemployment, the main cause of poverty, was much more severe in the Merseyside in 1932 than in the country as a whole. This was true of each of the industries considered, with the single exception of the clothing and textile industry. Over 70 per cent. of the unemployment in the Survey area was concentrated in the shipping, transport and distribution, and the building industries. The workers are discussed in considerable detail with reference to occupation as opposed to industry. The household sample was of particular value in providing information as to earnings. For nearly 4,000 occupied working-class males in Liverpool, of age 22 and upwards, the median amount actually earned in the week of the enquiry was 57s. 7d. or 53 per cent. above the minimum sum required for maintaining the typical working-class family consisting of man, wife and three children. The median wage of the 666 adult females covered by the sample was 26s. 2½d., rather less than half that of adult males. Boys and girls aged 14 and 15 begin at about 10s. per week, the tendency being for girls to earn rather more than boys. Whether some find work in better or worse occupational grades than those of the fathers is discussed at length in the chapter devoted to "Occupational Mobility," where it is shown that although the proportion of sons who have moved down is greater than that of those who have moved up, the latter travel slightly farther upwards than the former do downwards. Even so, the vast majority move up or down only a short way. The importance of trade and its workers in Liverpool and the subsidiary port services are indicated in a couple of chapters, from which it appears that Liverpool suffered more from the slump than any other of the five great ports of the United Kingdom. The incidence of unemployment, wages and general economic circumstances amongst workers on board ship is given special attention. Working conditions, including hours and wages, in each of the major industries take up nearly half of Volume 2, and the main factors accounting for the location of particular industries are also discussed. This volume, being wholly concerned with the industry of Merseyside, naturally concludes with a special examination of unemployment in the area and with the prospects of employment in the future. It is estimated that the labour surplus in Merseyside in 1932 (quite apart from the surplus attributable to the recent world depression) amounted to 22,000 men and

4,000 women. In addition, new entrants into industry during the five years 1932-1936 are estimated to exceed those passing out of industry by 37,000 for men and 39,000 for women. The probable effect on Merseyside industry of a general tariff is that the number of workers likely to suffer greatly exceeds the number of those likely to benefit. In general, those industries which would be among the first to recover with trade revival are those with relatively least unemployment.

The last volume is devoted to the non-earning population, the sub-normal classes, public administration, social services and to the use of leisure. A brief summary of Merseyside Local Government is followed by a survey of the Public Health services. In 1931-32, Liverpool spent over £23,000 in supplying milk and other foods to mothers and infants, or 25s. per live birth, whereas Bootle, Birkenhead and Wallasey spent rather less than half this average. Elementary education in the Survey area is dealt with fully in Chapter 3, but before secondary education is considered there is a chapter on Public Assistance and one on Infant Welfare. It is felt that the logical order of events would have justified the re-arrangement of these chapters. In a mine of information concerning the adolescent in the Merseyside the investigation as to how the boy or girl found work suggests the futility of answering advertisements. Less than $3\frac{1}{2}$ per cent. of the jobs were found by this means, whereas 40 per cent. were obtained by the adolescents' "own efforts." The assistance given by the Juvenile Employment Bureaus is much less doubtful: one-third of all jobs for adolescents was obtained through this medium.

"Broken families" are defined as those without an adult male earner, the main reasons for which are death, old age or disablement. The general and economic conditions of this type of household are reviewed, and it is concluded that the present system of social assistance is inadequate for this type of household. The suggestion is made that the pensions for aged widows should be raised to 15s. weekly, which would have a substantial effect in improving the conditions of many "broken families" now in absolute poverty.

Leisure is given a long chapter, while a separate (although the next) chapter is devoted to organised religion and Church attendance. The sub-normal classes of the population (*e.g.*, the deaf, the blind, the mentally deficient) are examined in detail with reference to family conditions and to territorial localization.

The Social Survey of Merseyside concludes with a discussion of the fertility of the population as between social and occupational classes, and finally with an account of the future trend of population.

The three volumes are amply illustrated with maps and diagrams, although one or two of the former (*e.g.*, on p. 356 of Volume 2 and on p. 487 of Volume 3) are not too easy to read. Wherever possible the material is given in tabular form, and all the essential data are concisely presented.

The Household Sample which, as already indicated, was the general basis of the Survey, was supplemented in very many cases by

special enquiries, so that every aspect is discussed in the light of adequate and very relevant information.

All those interested in the social life of the people will be indebted to Mr. Caradog Jones and his assistants for this remarkable achievement. The Survey has much more than local significance; its results and its lessons will be of value to all workers concerned with social investigation, wherever their enquiries are conducted.

R. F. G.

7.—*A Social Survey of Plymouth, A Preliminary Report.* By a Committee (Lord Astor, Chairman). London: P. S. King. 1935. 8½" x 5½". 36 pp. 1s. 6d. net.

Plymouth is a very interesting city for the sociologist. It is a place of great historical associations, and is an English community that is perhaps as little cosmopolitan as any of the greater towns of the country. It lies on the borders of a Celtic area. Its inhabitants are very largely of autochthonous stock, and the city forms an isolate, being some two hours from the next nearest city. In modern days it is largely parasitic in its nature, being a service town, for although there is some trans-Atlantic liner traffic, and it is a marketing centre for Devon and Cornwall, it draws much of its income from the Government. It has an excess of young men, and the civilians live in more households per house than in any other large borough outside the metropolis. There are thus many points that a survey might well bring out. The Survey under consideration was financed by the Rockefeller Foundation and by Lord Astor, and carried out by representatives of various bodies interested in the social problems of the city. Judging, however, from this preliminary report, the survey has not been more than superficial. Our comments fall under five main heads.

(1) A sample method was used, to investigate the conditions of families with an income not exceeding £5 a week. The method is not clear. "Every twentieth house was selected." Where? In even the non-working class districts? If not, how, with sub-letting as rampant as we know it to be in Plymouth, can we be sure that samples of working-class families living in houses in the better districts were not overlooked? Again, were small non-lock-up shops included? An impression of the city suggests that there are a large number of petty officers, and so forth, who leave the Royal Navy with a gratuity and a pension and invest in a small shop with residence attached, possibly sub-letting one floor to another family, with the result that there seems to be an unusual number of small shops in the city. Is this so? The Survey should throw light on this, and the method should guarantee that this question was investigated. But we cannot find that there is any recognition that it was a matter that needed consideration when the process of sampling the premises used for family occupation was under discussion.

(2) The interviewers were unemployed persons. This was, we believe, a decision forced on the promoters in order to allay local prejudice, which was very strong. But there were not 100 per cent. returns. We are told that there were "over 90 per cent. of the

possible returns . . . secured." There is no discussion on the representative nature of the returns actually obtained, but it seems justifiable to doubt if it was a typical sample.

(3) There is no copy of the questionnaire that was used. It is surely a fundamental that future investigators should be able to find out what exactly was asked for in the returns? Perhaps if we had this we might find an answer to some of the questions we have already asked. We are not even told how long the interviewers were on their job, but only that the work was begun late in 1933. Yet the money receipts of the family in the week previous to the visit is the basis of the income enquiry.

(4) What exactly is the statistical value of knowing that the average income of all families getting between 0 and £5 per week is £2 10s. 10d. If we choose an upper limit, then an arithmetic mean is of small worth. We surely have the right to ask here for a frequency distribution of the wages. In the same way, we should surely be given a double-entry distribution table for the number of rooms occupied and the composition of the family. If the sampling basis be as stated, *i.e.* one house in 20 was visited, then it appears that there is a bias in the method in favour of the better-off families. For if we rank all houses by social class, then we choose, perhaps, at the upper end each family in 20. But at the lower end the sample is much scarcer, for there are accumulations of families in the poorer houses, and if the distribution is anything like J-shaped these will be under-represented.

(5) The problem of the pensioned able-bodied ex-service man seems to have received very little notice. Is he regarded as a wage-earner? Apparently not (p. 26). He is not regarded as receiving social service income in respect of such pensions. We do not know how many of these men there are, for the Census of Population describes them, probably, as retired if they have no other job, and as something (*e.g.* retail shopkeepers) if they have one. This information is a matter where the Survey might well have helped, but the organizers apparently failed to realize their opportunity. Some of these men, particularly those who have just come out of service, may appear in the returns as unemployed.

The Survey as published confirms the Census figures about the very bad state of overcrowding in Plymouth, and strengthens the impression that, in spite of the city being relatively little hit by unemployment, the standard of wages, for young and older adults alike, is low, with resulting poverty. The workers on this Survey have a great opportunity of obtaining facts not otherwise accessible, and we hope that when their final reports come to be presented they will be worked up in such a form that they will be of service to all social workers, and to all interested in the conditions of life in Plymouth.

F. S.

S.—*Britain in Depression: a Record of British Industries since 1929.* London: Pitman, 1935. 8½" x 5½". viii—473 pp. 10s. 6d.

During the war of 1914–18 a Research Committee of Section F of the British Association published a series of volumes which con-

tain an account—adequate for most purposes—of industrial and financial changes necessitated by the crisis through which the country was passing. The work of the Committee attracted less attention than it deserved. . . . But the value of the reports to historians of the period is now more generally recognized.” Thus Professor J. Harry Jones, in an introduction to the present volume, which, like its predecessors, was prepared by a Research Committee of the Economic Science and Statistics Section of the British Association. The Committee of six members was presided over by Professor Jones and they had the assistance of twenty-one other colleagues; twelve of the whole team are Fellows of our Society.

Professor Jones in his general introduction sketches post-war economic history in three periods—1919–23, 1924–29 and 1930–35—and concludes by pointing out that while “the depression in the south of England has almost passed away, the large exporting industries are still suffering not only from the persistent depression of 1929, but also from a depression which is partly cyclical but largely of a kind that may continue for some years to come. A low rate of interest may foster the development of industries with a future; it can do little beyond providing financial relief for those industries that are already overgrown and need to be reduced. It may foster house construction, an industry which has been largely responsible for recent improvements in trade, but there is little to be gained in building houses without providing industries, to do so is like building castles in the air. The obvious immediate task with which the nation is faced is to repair the foundations of economic prosperity.” Five illustrative charts follow and then Professor J. G. Smith and Mr. G. J. Walker provide a general review of currency and banking since 1928, in which, however, the importance of the American financial boom and crash of 1929 and of the unusual imports of gold from India appear to be insufficiently stressed. Next, Professor J. Henry Richardson contributes a very satisfactory summary of industrial relations since 1927.

There follow twenty-one chapters dealing with separate industries: Agriculture (field crops; the milk industry; the live-stock and meat industry), Coal, Fuel and Power, Rail Transport, Road Transport, Shipping, Shipbuilding, Iron and Steel Industry, Engineering, Non-Ferrous Metals Industries, the Building Industry, the Cotton Industry, the Wool Textile Industry, the Hosiery Trade, the Seed-Crushing and Oil-Milling Industry, the Glass Industry, the Pottery Industry, Consumers’ Trades and Services, and National and Local Finance. “As far as is practicable, the section on each industry gives a brief statement of the position and problems of the industry before the onset of the depression in 1929, traces the main changes since that date, and provides a full bibliography.” It would require an encyclopædic knowledge to enable one to say how far those purposes have been achieved in each chapter; but so far as one can test, the several accounts are satisfactory, certainly for the general reader and in the main, also, for the specialist desirous of having a short sketch of the principal developments in the industry with which he is concerned. The bibliographies supplied are very

useful, and it is regrettable that similar statements have not been appended to the chapters on rail transport, shipping, and the hosiery trade. There are some misprints, e.g. the word "thousand" is omitted after the statement of the horse-power of gas-engines in line 9 of p. 178; in line 31 of p. 203, "872 metric tons" should plainly be "872,000"; some of the percentage increases shown in the first table on p. 436 look rather queer.

H. W. M.

9.—*Controlling Depressions*. By Paul H. Douglas, Professor of Economics, University of Chicago. London: Allen and Unwin, 1935. 8" x 5". vi — 286 pp. 10s. 6d.

"If labor fundamentally wants to retain the capitalistic system for most of industry it should most certainly acquaint itself with the terms under which capitalism can function. This process of adjustment would be helped if an unofficial board of competent and practical scholars were set up to carry on investigations and which would from time to time make recommendations. Although these studies would have no binding force upon labor, still if they were made in all honesty by men in whom labor had confidence the net effect could not fail to be helpful." Professor Douglas is a competent and practical scholar whose contribution to the study of depressions and the way out is at once vivacious and honest. After analysing various theories as to the genesis of depressions he sketches a most comprehensive twelve-point programme. He advocates public works, for "Governmental expenditure should move *against* the current of private business." Hence he would have a flexible governmental budget approximately balanced over a ten-year period. He is in favour of a managed national currency and a managed banking system.

As to the former, "A nation which enters upon a program of managed currency must expect to have its exchanges fluctuate." But even so highly internationalized a nation as Great Britain has derived advantage from choosing price stability even at the cost of unstable exchanges. Hence these advantages "would seem to be even more decisive in the case of countries such as the United States. Our volume of foreign trade even in boom times is small in comparison with our national income . . . while the nominal face value of our investments abroad is great, their real value is comparatively slight. No one expects the European nations to pay their war debts" (a fact English readers will be glad to learn on Professor Douglas's authority). ". . . We are in an admirable internal position for experimenting with a managed currency. . . ." Professor Douglas's views of American currency policy are very interesting. "Once committed to the program of public works, it was plainly immature to stabilize the foreign exchange rates at the same time. To do so would have tied our hands. The President's message to the London Conference gave us the freedom of action which we needed. There were two great virtues in the American policy which that of Great Britain did not possess." (It was open, not secret, designed to raise internal prices and not to give us the advantage of exchange dumping.)

The sufferings of the American public are clearly reflected in the rancour of Professor Douglas' section on banking. The bankers, whose manners and their very architecture are produced by the necessity of giving the public an illusion of security where none exists, are very much the villains of the piece. The scheme advocated here is that worked out by a group of Professor Douglas's colleagues in the University of Chicago. Private banking should be deprived of the power of creating commercial credit, and this function should be lodged in a socialized agency which will serve as the manufacturers and wholesalers of credit and with private institutions serving merely as retailers. This socialized agency is, in creating credit, to work on the principle of giving employment in depression and attempting to stabilize the general price level.

Professor Douglas, having got his general programme of control, is in favour of a flexible wage policy—a policy which calls for an upward movement of wage rates, if price and production *per capita* should advance, and vice versa. Flexibility in prices within the general price system in order to effect transfer from contracting to expanding industries, restoration of competition where possible, or socialization of that portion of the field of industry which tends inherently towards monopoly. These points in the programme are illustrated from the defects of the working of the N.R.A., the abuses of which lie in the price and production policies which have been fostered. These "have operated greatly to restrict the area of price competition and to enlarge that of monopoly. . . . The N.R.A. has virtually made it mandatory for the employers to combine."

To socialize the monopolies will, Professor Douglas says, "necessitate the formation of a new political party which will be well to the left of the present dominant Democratic party," but which would seem still to be a considerable way to the right of complete socialism. It is to be noted that the introduction of a Federal system of unemployment insurance is part of Professor Douglas's programme. He considers that it would be chiefly valuable in lessening business depressions through the transfer of purchasing power. He points out that the depression was far less severe, relatively speaking, in England than in America, and thinks it probable that the system of unemployment insurance was at least partially responsible for the difference.

H. L.

10.—*The Trade Balance*; a problem in national planning. By Lt.-Col. K. E. Edgeworth, D.S.O. London: Allen and Unwin, 1934. 7 $\frac{3}{4}$ " x 4 $\frac{3}{4}$ ". 135 pp. 3s. 6d.

The Price Level. By Lt.-Col. K. E. Edgeworth, D.S.O. London: Allen and Unwin, 1935. 9 $\frac{3}{4}$ " x 6". 165 pp. 4s. 6d.

These two books have the merits of a certain facility of exposition and of a flavour of originality in the ideas put forward. But the author's treatment of his subject sometimes suggests a rather slender technical equipment, whether in economics or in business.

In *The Trade Balance*, actuated by a somewhat exaggerated view of the difficulties and dangers of fluctuations in the balance of payment, he proposes an ingenious plan for varying the gold

value of the currency unit. According to this plan there would be no large and arbitrary changes, but notice would be given from time to time that the gold value of the unit would be increased (or decreased) by a fixed small weekly percentage. Colonel Edgeworth suggests that the percentage should not exceed 0.04 a week or 2.08 a year. An excess of exports (or imports) would be corrected by announcing a gradual appreciation (or depreciation) of the currency unit on these lines. The author contends that besides the ultimate corrective effect of the gradual rise (or fall) of the currency unit, there would be an immediate effect on short-term international borrowing. A prospective rise in the unit would discourage lending abroad and encourage borrowing abroad, and so would "tend towards reducing exports and encouraging imports" (p. 81). Colonel Edgeworth has here strayed a little from the path of clear thinking. A diminution of lending abroad only tends towards reducing exports in the sense that it requires a reduction of exports in order to preserve equilibrium. In itself it does nothing to secure this and far from helping to remedy the disequilibrium, it actually intensifies it for the time being.

Colonel Edgeworth also points out, quite rightly, that, with an appreciating currency unit, a low bank rate can be lower than it would otherwise be, and that, with a depreciating unit, a high bank rate can be higher. But he is mistaken in supposing that a more marked effect upon trade activity would result. For the prospective change in the currency unit tends to have an effect on activity the contrary of that of the bank rate.

In *The Price Level* Colonel Edgeworth has much to say as to the effects of fluctuating prices, but he fails to bring out the essential relation between the price level and the balance of payments. In practice the difficulty of dealing with an adverse balance of payments arises in an acute form only when a country finds an abrupt appreciation of its currency unit in terms of commodities imposed upon it by a world deflationary movement. In such circumstances a reduction of the gold value of the unit by such minute steps as he proposes would do little to mitigate the pressure. He regards a gold standard with rigidly fixed parities as impracticable, but his variant, with the rigidity very slightly modified, is scarcely less likely to break down.

He looks forward to a system of stabilizing the price level, and thinks there is good reason to assume that a reasonable measure of stabilization is a practicable possibility. Given stabilization of the price level, "the chief buyers . . . of gold are the central banks, and it is simply necessary for these institutions to act together and they can fix the price of gold at any figure they please" (*The Price Level*, p. 109). That is to say, it is practicable to stabilize the price level of commodities in terms of gold. Surely that will itself reduce within narrow limits the troubles feared from a gold standard, including the fluctuations of the balance of payments.

In his discussion of methods of regulation Colonel Edgeworth is led astray by a false distinction between monetary regulation which governs the price level and credit regulation which governs

business activity. And his final recommendation is for a regulation of the price level through the wage level, which seems singularly ill chosen. When a rise of prices is desired, that is usually because prices are too low *relatively to wages*. To raise wages is to accentuate the disequilibrium. R. G. H.

11.—*The Problems of the Foreign Exchange*. By L. L. B. Angas. London: Macmillan, 1935. 9" x 6". xiv — 273 pp. 20s.

This is the second part of a trilogy, standing between *The Problems of Money* and *Methods of Preventing Unemployment and Bad Trade*. It is, in the first place, an admirably clear and pithy statement of the theme that "There is in fact an inherent conflict between the rigid gold standard and a stable internal measure of value—this and internal money and trade fluctuation are the necessary corollaries of fixed gold exchanges" (p. xiii), or, as Mr. Angas puts it gnominically in his analysis of the four different sorts of Confidence (p. 271), "Business [Confidence] and Monetary Confidence are largely in conflict—Confidence in Money is created by Deflation, which destroys business confidence."

Mr. Angas points out (p. 50) that the authentic gold standard has never yet been worked *properly*. Before the War a manipulated sterling loan standard was in operation. From 1925 onwards . . . the world was required to work the authentic gold standard according to the rules, which democratic nations found impossibly harsh. (These rules are, (i) free gold movement, (ii) deflation on loss of gold and vice versa, (iii) free trade in creditor countries.) Thus "in order to prevent the gold standard from working according to its Spartan rules, much more economic nationalism is fostered than is ever likely to be fostered by managed paper." The crux of the problem is stated as follows: "Unless foreign trade is controlled by the Government the exchanges have a definite function to perform, namely, to act as an automatic 'corrector' to haphazard inequalities between imports and exports. There are two alternative correctors, namely, fluctuating exchanges and fluctuating internal prices—the function of the exchanges is not to remove all forms of fluctuation . . . but positively to make 'net external prices' fluctuate so as to augment exports, check imports and secure the export-import equation. Thus stable money and stable exchanges are mutually incompatible. A choice must be made of the lesser evil, the decision being taken from a nation-wide point of view" (p. 196). Paper is the quickest, the fairest, and though disturbing, the least disturbing of internal correctors. Paper does not prevent the adoption of those remedies by which alone . . . unemployment can be prevented (p. 181). Mr. Angas prefers paper, but in view of the natural shrinking from fluctuating exchanges he proposes a variable gold standard with a limited variability. This consists "in widening the gold points till there was an 'écart' of about 5 per cent., the Central Bank being allowed to vary its gold buying or selling prices within these limits as it thought fit. Such a system [Mr. Angas thinks] has many merits, for it has nearly all the advantages of paper without the 'shocking' effect of complete gold

abandonment." He does not, however, expect to see any such scientific system introduced, but believes that the "gold standard will nominally be retained for some years, though in practice it will be operated on the principles of paper."

Mr. Angas has some penetrating criticism of the mentality fostered by the atmosphere of the City. "International bankers and international traders must be supermen if they do not tend to look at national welfare to some extent from the point of view of their own immediate business environment" (p. 184). "For the Government to consult the international banking community or the Directorate of the Bank of England as at present constituted is merely to consult a body of men who by the very nature of their callings are probably somewhat biased." "What does the gold standard versus the paper standard boil down to? An intellectual battle on matters of principle between experts, coupled with an economic conflict between vested interests: Army Number 1 consisting of international bankers engaged in foreign commerce and finance, whose personal interests naturally make them support the gold standard so that the painful burden of the international corrector may be shifted on to the rest of the community; and Army Number 2, the rest of the community, who benefit from stable internal money rather than from stable exchange." H. L.

12.—*The International Banks.* By A. S. J. Baster, Ph.D. (London), Lecturer in Economics, University College, Exeter. London: King, 1935. 8 $\frac{3}{4}$ " \times 5 $\frac{1}{2}$ ". vii — 269 pp. 12s. 6d.

Dr. Baster is already favourably known by his book on *The Imperial Banks* (reviewed in the *Journal*, 1930, Part IV), and in the present work he has made another important contribution to banking history in a sphere where little is generally known and much suspected. For this we owe him our thanks.

In an introductory chapter mention is made of the extension of the London money market during the continental war and in the early part of the nineteenth century owing to the more settled condition of England and the growth of the British mercantile marine. "International banks exist mainly to transfer capital, in one form or another, from countries where it is cheap to countries where it is dear." The function of the "merchant bankers" was that of managing long-term foreign loans, but during the second half of the nineteenth century new business arose in accepting "bills drawn by consignors abroad, on behalf of importers, factors, or merchants." The great deposit banks kept clear of acceptance credits, but banking connections abroad are "the first essential for an expanding foreign trade" and have been the cause of the establishment of a large number of banking companies for this special purpose. Their fortunes form the theme of Dr. Baster's book, and after a chapter on the common difficulties, technical, legal, and political, of operating abroad he proceeds to a history of developments in various geographical areas.

The banking mania of the 'fifties and 'sixties spread to the Continent. But the invasion of British banking interests proved neither

safe nor profitable and their career added little to the credit of British financiers. Nor is there much to be proud of in the history of British banking in the Near East, where the operations of the international banks were chiefly confined to the financing of profligate potentates in return for high interest and commercial or political concessions. It was not till those gentry were expelled that the banks found their main advantage in financing genuine trade, and in that capacity the British banks have approved themselves. Notoriously the French, German, and Russian governments controlled and supported the banks of their nationalities in order to utilize the power of finance for the furtherance of national purposes supposedly important. The British Government was more chary of exerting this kind of influence, but at times did support British financial interests in Persia. The story of British banking in South America is far more satisfactory, for during a period of repeated revolutions and flagitious money policies the great international banks owned in London kept free from politics and established a high reputation for honesty and ability. Their work in developing trade between South America and Britain was invaluable; it was real financial pioneering. In the Far East the Exchange Banks of India and the Agency Houses conducted the financing of trade, and later came the Oriental Banking Corporation and the Hong Kong and Shanghai Bank. Opinions will vary as to the policies of the Great Powers in the exploitation of China and the flotation of the numerous loans which are now often of little profit to the holders.

By the outbreak of the European War there was intense competition between the international banks of various nationalities, and since its end the great growth of "economic nationalism" and the profound distrust of foreign finance engendered in the undeveloped countries by the burden which foreign loans have been found to impose in a time of depression have seriously threatened the international banks. Dr. Baster's final chapter on this subject will repay careful study. The book ends with a collection of financial particulars relating to the chief banks. H. W. M.

13.—*The Clash of Progress and Security*. By Allan G. B. Fisher, Professor of Economics in the University of Otago. London: Macmillan, 1935. 8 $\frac{3}{4}$ " \times 5 $\frac{1}{2}$ ". viii + 234 pp. 8s. 6d.

Professor Fisher's theme is that while material progress is necessary, it "means change, and change frequently inflicts much inconvenience and suffering upon individuals directly affected. . . . The modern world for the most part desires material progress, but with equal emphasis it also for the most part does not desire the changes without which material progress is impossible." We can distinguish between changes in demand and improvements in the efficiency of production, both unpredictable. "If we allow the economic organism to make the proper responses such improvements make possible higher income levels" with consequent changes in the demand for goods and services. Three stages can be traced: (a) the primary producing stage of agriculture and pastoral pursuits; (b) the secondary stage of the manufacture of necessities and luxuries;

and (c) the tertiary stage of the supply of services of various kinds and special luxuries. Progress through those stages has been made possible by scientific advance which has increased production to the satisfaction of current needs, "but we cannot enjoy the benefits of plenty unless we organise the production capacity which has been released, so that it can be applied to the production of new things hitherto little known or even entirely unknown. . . . We must certainly be prepared for drastic changes in our traditional outlook towards those industries which we are in the habit of describing as 'basic.'" The fostering of agriculture, tariff protection of manufactures, restriction of the entry into occupations—these are all policies arising from the resistance to change of occupation, and hamper progress. "The only permanently satisfactory method that has ever been discovered for diminishing unemployment in a capitalist society is the encouragement of people to enter occupations and industries which are a little more prosperous than the average." The fear of individual loss through investment error and the resistance of vested interests to new competition are important obstacles, but after a detailed argument "the conclusion appears to be justified that persistent refusal to make the transfer of labour and capital which material progress demands is likely ultimately to lead to a general depression in all industries and not merely in the industries in which there is in the first instance chronic over-supply." It has been suggested that the transfer problem would be eased by the institution of a shorter working day or by a redistribution of incomes, but the former would only change the form of the transfers and production cannot be organised on the basis of a redistribution of income which has not yet taken place. "Technological unemployment will disappear only if the hypothesis that we want the adaptations demanded by material progress is sound." The need for transfers will be greater in a rich community, where in a period of technical advance "the economic problem is the problem of deciding first how much of each thing is to be produced." The speed of improvements and of their adoption will increase the need for transfers, and so will improvements in industries producing goods of inelastic demand. The elasticity of new demands and their permanent or transitory character are other factors. The extent to which improvements occur simultaneously in different industries, the rate of population-growth, the availability of raw materials, the trend of prices and of business conditions—all these affect the need for and the resistance to change. Where prices are rising the urge to investment in new industries is greater, but the small investor must play for safety. Not only changes in demand or in production act on prices but also monetary influences, the swing of the trade cycle, and long-term movements of gold. Stability of prices is to-day a common aim, but reductions due to greater efficiency should not be prevented but should be allowed to reduce the cost of living; otherwise "the appropriate relations between the different kinds of production will be disrupted" and capital and labour will be poured into industries already oversupplied.

The author's practical suggestions are:—(a) an educational

policy calculated to provide an adequate supply of people competent to perform the newer skilled services; (b) a credit policy "making possible the price movements which will give to entrepreneurs correct indications as to the directions in which it is desirable to retard or to accelerate the flow of capital"; (c) "we certainly do not need any more organised large-scale land settlement"; (d) large-scale migration is no longer important or possible; (e) the capitalist has lost his old venturesomeness and appropriate institutions, such as those recommended by the Macmillan Committee, are required to facilitate new industrial developments; (f) possibly an extension of "communal control" to provide through taxation some of the tertiary services and thus make the other fields of investment more stable for individualist activity; (g) more scientific research.

Professor Fisher concludes that the present situation is a challenge to capitalism. Capital is no longer risk-bearing, and private interests dominate the common weal. "Sensible action will be impossible unless control is taken out of the hands of people who find that sensible action conflicts with their own interests." "Actual practice reveals little conformity with theory, and the capitalist cannot be allowed indefinitely to refuse to shoulder the responsibility for bringing the two into line." Professor Fisher has treated with great clarity and thoroughness a department of economics which has generally been passed over with a few easy sentences, and his book is certainly provocative of thought.

H. W. M.

14.—*The Depreciation of Capital Analytically Considered.* By R. F. Fowler. London: P. S. King, 1934. xii + 143 pp. 6s.

This volume is a contribution to a very timely problem in economic theory. A number of the problems in current studies of equilibrium in a stationary economic state arise out of the difficulty of ascertaining precisely what is meant when it is said that capital is to be maintained intact. The difficulty arises through the depreciating nature of capital goods, with the consequence that such depreciation must somehow be made good if the capital is to remain intact. Again, the problem of depreciation is of interest to the accountancy profession. The case of *Rex v. Kylsant* showed how easily excessive depreciation could be charged, thereby creating secret reserves to be drawn upon in future years; while apart from this special issue the problem of depreciation is of great importance, for it becomes necessary to qualify auditorial dockets when assets are stated in a balance sheet at a value insufficiently written down.

Mr. Fowler's book, although far from being of the exhaustive nature that one would expect from the title and the announcement on the dust jacket, raises a number of interesting points. Such points are:—what is meant by maintaining capital intact? how are depreciation allowances and replacement provisions affected by price variations? what are the effects of differences between the rate of construction and the rate of depreciation of capital goods? how do variations in the durability of a capital good affect the charge for depreciation and the burden of interest cost? Mr. Fowler also shows that the capital reclaimed by deducting depreciation from a firm's

receipts is an important source of new capital which is often neglected, and demonstrates that the tendency to re-invest this capital in the firm hinders the mobility of capital. He also raises some problems for the attention of accountants, but his discussion of these adds little, if anything, to current knowledge.

Although Mr. Fowler raises so many interesting economic problems, it can hardly be said that his discussion of them is very satisfying. Indeed, it is difficult to recall a volume, even of greater length, containing so many phrases which are true under only very limited conditions, and with so many sentences which are quite inaccurate. The existence of a condition such as this suggests that it is in his basic and fundamental assumptions that Mr. Fowler fails to carry conviction, rather than in his deductions from these assumptions, and it is suggested that there are three very fundamental faults underlying this volume.

In the first place, although he raises the question of defining precisely what is meant by maintaining capital intact, and it is surely necessary to preface any discussion of depreciation from the economic point of view with a satisfactory answer to this question, Mr. Fowler does not put forward any such answer. Under cover of this omission he is therefore able to define intactness (by implication) sometimes as a constant money cost of constructing capital goods and sometimes as a constant productive power.

The second fundamental fault lies in Mr. Fowler's method of economic analysis. His standard method of approaching a problem is to study it in very simplified conditions, but after arriving at his conclusions he is apt to overlook the assumptions by which these conclusions were arrived at, and to apply them without limitation to the economic world generally. His chief analytical tool is so conceived and so used. Thus, making very abstract assumptions he introduces conditions under which capital goods will be "half worn out" and proceeds to apply this conception to a less simplified economic world. A number of other conclusions, arrived at under equally simplified conditions, are similarly applied.

The third basic error, and one which lies beneath much of Mr. Fowler's reasoning, is a failure to appreciate just precisely what it is that an accountant means by depreciation. He fails to see that accounting and economic conceptions of depreciation are *not* the opposite sides of the same medal; the one being labelled "practical" and the other "theoretical." The accountant intends by his depreciation allowance to ensure that "profits" will contain no element which is a return *of*, as distinct from a return *on*, capital; while the economist makes a depreciation allowance to enable him to maintain capital intact. These are two very different reasons. The economist is concerned with the source of the receipts, while the accountant looks to the receipts themselves. The accountant is not concerned with the replacement of the worn-out plant—this for him belongs to the problem of sinking-fund allowances—whereas the essential element of the economist's conception is that the plant is replaced. The accountant maintains that there is nothing inherent in the nature of depreciation which involves replacing the

loss of capital, and that it is only the introduction of some other idea, such as that of maintaining capital intact, which creates the demand for replacement. It is therefore quite impossible to square or even to compare the implications of the two views.

It is rather surprising that Mr. Fowler did not perceive this gulf, for he even quotes one of the standard accounting definitions—that the depreciation “provision is not to cover the cost of future renewals, although it will be available to be applied to or towards that cost.” Marshall, of course, pointed out that supply price includes an allowance for wear and tear, but supply price and cost of production are not the same thing. Supply price includes not only a return on the capital employed, but also a return of capital (or “disinvestment,” as Mr. Fowler aptly terms it) to the extent that the assets are being worn out or are growing obsolete. Supply price accordingly covers all revenue charges, prime and overhead, and includes in addition a return of capital. The precise nature of depreciation, therefore, is that it must be covered by price although it is not a cost of production.

In addition to these fundamental misconceptions Mr. Fowler has a manner of throwing out condemnations of accounting technique on grounds which, so far from revealing inadequacies in that technique, engender only suspicions as to the intimacy of the author's acquaintance with the technique. These suspicions may be unworthy, but they do inevitably arise, not only from the reasons behind Mr. Fowler's strictures, but even from some of his most casual statements on accounting practice. And above all, it is surely very surprising to find in a work on depreciation, that the only reference to the wear-and-tear allowance granted by the Inland Revenue is inaccurate. G. F. T.

15.—*The Thrifty Three Millions*: a Study of the Building Society Movement and the Story of the Abbey Road Society. By Sir Harold Bellman. London: Abbey Road Building Society, 1935. 8½" × 5½". xii + 357 pp. 5s.

The occurrence of the Diamond Jubilee of the Abbey Road Society afforded Sir Harold Bellman, he says, the opportunity of bringing up to date an earlier book which he had written some years earlier, *The Building Society Movement*, and all students of social developments will be grateful to him. A building society does not build houses, but is a “combination of investors and borrowers operating under a measure of Government control to promote the ideals of thrift and house-ownership.” The first society with those objects which the author has discovered was at Birmingham in 1781; and the first Act of Parliament to regulate the operations of such societies was passed in 1836. The period of the “industrial revolution” was one of great misery in which one important element was the disgraceful state of housing. The reaction of the working classes to the pressure of their environment was the development of the friendly societies, of which the building society movement was an important part. “It was a characteristic product of the period, one of many institutions operating on lines of mutual self-help which

the workers of the time created to satisfy their needs; and it was a development which, considered as a whole, was peculiar to the genius of the English earning class." The growth of the societies was slow at first, but progressed as the condition of the working classes improved. They were at first of the terminable type and the first permanent society was established in 1846. A Royal Commission on Friendly Societies reported in 1872, and as a result the Building Societies Act was passed in 1874. About that time the aggregate resources of the societies totalled only £17 million. The Abbey Road Society was also founded in 1874 and the story of its growth is skilfully interwoven with the history of the movement. In 1913 the total assets of all the 1,550 societies exceeded £65 million, but there was a slight falling off in 1915-17. In 1933 there were 1,013 societies with 1,747,880 members and total assets exceeding £501 million, including £423,500,000 of balance due on mortgages. These figures show the immense contribution of the building societies to the filling-up of the post-war shortage of houses. Readers will find this book not only instructive but full of interest, and very easy to read.

H. W. M.

16.—*Railways and Roads in Pioneer Development Overseas.* By J. E. Holmstrom. London: P. S. King. 1934. 9" x 6". 304 pp. 15s. net.

The function of transport in a new country is to foster the growth of industry and to produce with it such a distribution of population and resources as is necessary to induce political and social development. It is not until quite a late period that the problem becomes one of harmonizing restriction of the growth of competitive transport agencies with the necessity for facilitating distribution with due regard to its true costs to the consumer.

In this thesis, which has been approved for the author's Doctorate of Philosophy, an attempt is made to determine the conditions under which either rail or road transport becomes preferable in undeveloped territories, and to establish a technique based primarily on costs to enable the direct choice to be made or the functions of each agency to be adjusted where both forms may be justified.

The physical and economic structures of each type of inland transport are examined and the true costs of the provision and sale of the service analysed in relation to the ultimate cost to the consumer. The question is largely that of determining the true proportion which "fixed" costs, *i.e.* those incurred in the establishment of the service, bear to those which vary with the amount of service performed. In this connection it is doubtful if railway authorities would agree that such items as depreciation of track and rolling stock should be treated as almost wholly "traffic variants." Efficient maintenance in either case ensures a proper standard of repair, and depreciation reserves are frequently a means of replacing obsolescent assets. Rolling stock must be provided to satisfy maximum requirements and cannot vary with the traffic except over relatively long periods. The author rightly insists that remuneration of railway capital must be an ingredient of the costs whatever form the

ownership may take, but some postponement may be desirable until the system becomes remunerative if the position is not met by state guarantees.

The indirect benefits of railways in creating appreciation of land values and as a part of the means of defence are adequately defined, and it may well be that these would in many cases to-day count heavily in favour of railways even at the risk of financial loss in their operation. Nevertheless the advantages of road transport are well stated, particularly as regards its elasticity and initial cheapness.

The author assembles some valuable data relating to the capacity of the various carrying agencies from human portage to a complete railway system, and proceeds to state the factors of the problem. At once he encounters the familiar obstacles of establishing an economic balance between the items comprising the "fixed" charges and of their allocation over varying kinds of traffic. If upon these are superimposed the disturbing effects of external forces upon the markets which supply the labour and material, the magnitude of the problem becomes apparent. Yet it is upon the solution that the basis of the costs to the consumer must rest, and it is hardly surprising that, as the author states, operators in many countries have met disaster "aggravated by total ignorance as to the most elementary principles of prudent business, by lack of any provision for depreciation and by the presence of an inexhaustible supply of optimists." Examples of this are by no means confined to overseas countries.

The detailed examination of the true and consumers' costs of rail and road transport is illustrated by a quantity of admirably presented data relating to several countries. From this are evolved, of necessity somewhat arbitrarily, typical costs for given densities of traffic, and finally, weighting of the true costs of rail and road transport is suggested to determine their respective ultimate values. Over-centralization and state control are weighted against the railways, and it may be that these reflect the "characteristic vices of government departments the whole world over." But there can be few cases where either railway or road systems will of themselves adequately perform the service, and if both are desirable, the function of ownership should be vested in a single financially autonomous authority. That this need not necessarily involve political considerations is proved by the constitution of the London Passenger Transport Board and similar undertakings.

Lecturers in transport will appreciate the difficulty of inducing students to view the subject as a whole, and one is particularly grateful to the author for his anatomical diagram of the transport system and its conception as a single organism absorbing and re-synthesizing wealth. But the appeal of this work is by no means limited to its academic value.

H. G. L.

17.—*The Agricultural Dilemma*. Report of an Enquiry organized by Viscount Astor and Mr. B. Seeborn Rowntree. London: P. S. King. 1935. 8 $\frac{1}{2}$ " \times 5 $\frac{1}{2}$ ". 101 pp. Price 2s. 6d.

Lord Astor explains in a preface that this enquiry was undertaken as a consequence of the divergent opinions which were

expressed in regard to proposals for land settlement and increased home food production. At the outset, there was a bias, if anything, in the direction of large-scale land settlement schemes, but it was agreed that the enquiry should be conducted in a spirit of pure research "to search for the truth and nothing but the truth, even if, when discovered, it caused us to modify our existing opinions." The result is that we have here in a brief compass a considered view of the basic principles on which certain aspects of British agricultural policy should be based. A distinguishing feature is the endeavour to view the problem from a wide angle and to give due weight to far-reaching considerations, which may ultimately be of more importance than those more purely agricultural.

The possibility of increasing home food production and, as it is hoped, thus providing greater employment on the land, is necessarily dependent, at least in part, on a drastic restriction of food imports. The Report, while recognizing the need under existing conditions for some moderate degree of protection, emphasizes the very serious consequences which might ensue from any attempt at such drastic curtailment of imports as would be necessary to secure a substantial increase in domestic food production. "It would strike at international trade at one of the points where its mutual advantages are conspicuous and indisputable. It would entail for Great Britain a substantial rise in the cost of living, a further loss of export trade, and an increase of unemployment in the exporting industries. It would imperil the solidarity of the British Empire and our relations with other food producing countries."

An alternative would be to secure an increase in home consumption, but this, when examined, does not offer much encouragement. A rise in the standard of living would have some effect, but not sufficient to be of importance. For example, if the consumption of one-fifth of the population were increased by 20 per cent., which is more than could reasonably be expected even with the help of a subsidy, the aggregate consumption of the community would only be raised by 4 per cent. Moreover, technical progress in agriculture and the adoption of labour-saving devices are resulting in a steady decline in agricultural employment. The prospect of reversing this tendency is negligible.

Finally a review of the system of small holdings was found to afford no support to the idea that it is capable of any large extension at the present time, still less that it could be used on any considerable scale as a means of absorbing the industrial unemployed. Thus after reviewing the question from all points of view, the authors reluctantly conclude that "the idea of a material increase in the agricultural population consistently with the maintenance of the national economic prosperity must be dismissed as chimerical." This, however, does not altogether exclude the possibility of carefully considered experiments designed to settle on the land a proportion of suitable workers from the industrial areas, though the scope for them appears very limited. A more encouraging view is taken of the system of allotments as a useful contribution to the relief of unemployment in the distressed areas.

R. J. T.

18.—*International Wheat Policy and Planning.—Wheat Studies*, Vol. xi. No. 10, June 1935. Stanford University, California. 8½" × 11". 46 pp. 75 cents.

This memorandum by Dr. Alonzo E. Taylor is a criticism of the schemes of the International Wheat Conference and of the whole conception of "planning" the international production and distribution of wheat. Dr. Taylor is the Director of the Food Research Institute chiefly responsible for the very valuable work on wheat which it undertakes, and is consequently in an exceptional position to express an opinion on this question.

Much of the memorandum is devoted to explaining the enormous technical difficulties which stand in the way of any international control, such as the difficulty of accurately forecasting import requirements and export surpluses, the complications introduced by the many kinds and varieties of wheat, the intricate administration involved in any efficient control, and the problem of effectively securing reductions or adjustments of acreage. The wheat importing countries, for example, have steadfastly refused to contemplate any reduction themselves and have thrown the whole burden on wheat-exporting countries, not one of whom except the United States has made any effective move in this direction.

Dr. Taylor sums up his views by saying that it seems quite impossible for a realist in international affairs to have faith in a planned adjustment of wheat production to consumption by means of international agreement on acreage, exports, utilization and prices. International planning of this kind presupposes good intentions on all sides, comprehensive and adequate information, an appropriate body to carry out the plans, and the political and commercial "discipline" in the various countries in order that compliance may be enforced. All these, and particularly the last, seem to be lacking.

As an alternative, Dr. Taylor discusses the practicability of increasing consumption. Increased buying for human needs would obviously help to solve the problem of the wheat surplus, but as the maintenance of high internal prices is at present an essential part of the policy of most European countries there is little hope from this source. Another method of increasing consumption is to reduce the rate of flour extraction, and it is estimated that if the average rate of extraction were reduced by 5 per cent. all round, requirements would be raised by 100 million bushels. Here again many factors intervene. Although quality would be improved, flour prices would be raised and the supply of mill offals increased, with consequent reactions on the price of competing feeding stuffs. In any case, to be effective, this proposal would need more or less universal acceptance, and of this there seems little prospect.

There is no doubt that Dr. Taylor makes out a strong case against international control in existing circumstances. As he says, "If the ship of the world were riding on an even keel, as was the case before the war, an international adjustment of production to utilization of wheat might fairly be regarded as feasible on technical grounds, though inherently very difficult. But the abnormal circumstances of to-day make such international planning at once self-deceptive

and self-destructive." As regards the International Wheat Conference, however, he seems to go too far. The members of that body were, no doubt, fully aware of all the difficulties and had no illusions as to the possibility of establishing a permanent control. They merely drafted a short-period scheme which, under the conditions that then existed, seemed to offer some hope of improving the world wheat position. They probably learnt, without surprise, that they had been too optimistic.

R. J. T.

19.—*Considerations on the Present Evolution of Agricultural Protectionism*. League of Nations, Economic Committee. London: Allen and Unwin, 1935. 10½" × 8". 49 pp. 1s. 6d.

This report consists of three parts, an introduction (10 pages) of "a few observations of a general character," chiefly on the second part (21 pages) which is a "personal note" by Sir Frederick Leith Ross on the problem, and a sketch (14 pages) by the Secretariat on the evolution of agriculture and the growth of agricultural protection during the last third of the nineteenth century and the pre-war portion of the twentieth.

Sir Frederick Leith Ross's contribution should become a classic on this subject. It is written in the calm, almost colourless, language of an official report, stresses no point unduly, admits all reasonable qualifications, and is completely fortified, without being overburdened, with statistics. To summarise briefly: after the war the chief incidence of protective duties was on industrial rather than on agricultural products, but by 1925 European agriculture was restored and duties on agricultural products began to be raised in the interests of "self-sufficiency," while "trade in manufactured products between 1925 and 1929 was subject to considerably less restriction than in the preceding years." After the depression began in 1929 each European country tried "to shield its own agricultural industry from depression or even to encourage its expansion in order to provide employment for some of those thrown out of work by the decline of industrial activity." Import duties were raised steeply and, while on exterior markets prices fell rapidly, domestic prices rose, in some cases to three times the British price. European imports were reduced, but so too was the consumption of certain foods: for example, fats and eggs in Germany.

Overseas countries exporting primary products were affected by the decline in the demand for industrial raw materials that developed during the slump and by the cessation of the international movement of capital after 1929, but a main cause of their difficulties has been the protection of agriculture by industrial countries. The export trade of the non-European agricultural countries declined in value from 1925, and when the lending of capital ceased in 1929 they were far less able to finance their imports; at the same time bad harvests out of Europe coincided with good harvests in Europe. The resulting fall in prices was precipitate and forced those countries off gold while at the same time they raised their duties on manufactures in order to restore their balance of payments. "By this means, the centre of gravity of the world depression was shifted

from the agricultural countries to the industrial countries themselves." Also, "the shortage of manufactured products in the agricultural countries stimulates the development of local industries in those countries."

Sir Frederick's conclusion is that "it is surely in the interests of all countries to promote as rapidly as possible a more economic system of production and interchange of commodities between the industrial and agricultural countries." The League Committee holds that "kept within reasonable limits, as practised before the war, agricultural protectionism represents indeed only one form—possibly the most important—of voluntary redistribution of national wealth to which it is hardly fair to apply the abstract standards of pure criticism," and that "it is quite conceivable that a country may prefer to make sure of a strong agriculture and rather less prosperity than to seek its wealth in what it regards as over-industrialism." The only way out of the present troubles, in its opinion, is to be found in convincing the agriculturist that only moderate protection is effective; too high protection leads to over-production at home and a fall in prices, and by reducing world trade makes industrial workers less able to buy farm products.

H. W. M.

20.—Other New Publications.*

Davis (Joseph Stancliffe). Washington, D.C. Wheat and the A.A.A. 468 pp. 3\$. *Black (John D.)*. Washington. The Dairy Industry and the A.A.A. 520 pp. 3\$. *Fitzgerald (D. A.)*. Washington. Live Stock under the A.A.A. 384 pp. 2.50\$. The Brookings Institution.

[These works represent studies of the operation of the Agricultural Adjustment Act undertaken on behalf of the Brookings Institution. They are to be followed by three others dealing respectively with tobacco, cotton, and marketing agreements, the whole series concluding with a report which will review the broad results of the Act "upon the business of agriculture, upon the consumer, and upon the national economy." The Brookings Institution is in an especially favourable position to undertake an investigation of this kind, and those interested in American affairs will find in these three preliminary volumes an unbiassed account of the first two years' working of the Act.

The Agricultural Adjustment Act is remarkable not merely on account of the magnitude of its scope, but also for the vagueness of its provisions. Although described as an Act "to relieve the existing national economic emergency by increasing agricultural purchasing power," it did not, in itself, prescribe definite measures of farm relief, but was an enabling Act which gave almost unlimited authority to the Secretary of Agriculture to employ a wide range of devices, without a positive mandate in regard to any of them. This was, of course, due to the fact that it was an emergency measure hastily passed and embodying, in order to secure agreement, most of the varying remedies which were being pressed upon Congress. There was, however, one principle which was declared to be the policy of Congress, viz. the establishment of "parity prices," that is a

* See also "Additions to Library," p. 230.

parity between the selling prices of agricultural commodities and the commodities which farmers buy corresponding to that existing in 1909-14; this, moreover, was accompanied by a provision intended to protect consumers by avoiding an increase in retail prices above the base level.

Necessarily, the measures taken were extraordinarily complex, including as they did the reducing of production by means of contracts with producers involving payments for non-production and taxes on the processing of the principal farm products. What degree of success has been obtained seems uncertain: it varies with different commodities and with the point of view, while in addition there is doubt as to how far improvements in the farming position have been due to the operation of the Act and how far to natural causes. As one of the workers remarks, "a Government Agency was called upon to undertake something which nobody knew how to do, and which perhaps could not be done at all under existing limitations."]

Mackenzie (T. Findlay). Nationalism and Education in Australia, with special reference to the State of New South Wales. London: P. S. King, 1935. 8½" × 5½". 448 pp. 8s. 6d.

[The author (whose name is followed by the description "Department of Economics," Brooklyn College, New York) admittedly set out to establish the connexion between the educational system of the Australian Commonwealth and the national ideals, especially in so far as they are British and Imperial ideals. What he has done is to give a straightforward account of the development of the educational system of New South Wales, taken as typical of the whole Dominion, prefaced by a sketch of the conditions in which the system germinated, while his "Conclusions" consist of a skeleton summary of the facts already related. Thus the book can scarcely be said to have achieved its object. Indeed, it concludes with "Problems for Further Investigation," the first being "to trace the emphasis on British Nationalism as manifested in the curricula of the schools of the State of New South Wales."]

The facts are there, however, and the book has a good index, a full bibliography, and two maps.]

Mukhtar (Ahmad). Trade Unionism and Labour Disputes in India. Bombay, London, etc.: Longmans, 1935. 8½" × 5½". 251 pp. 10s. 6d.

[Dr. Mukhtar, sometime Assistant Commissioner of Labour at Bombay has had altogether fifteen years of association with Indian Labour conditions. In his foreword he urges the need for a better understanding of the Labour problem in India, and in the book he has done his best to provide material which will help people to attain that understanding. The first and much the longest chapter is a historical account of the struggles between Capital and Labour in India; the next two deal respectively with the law and the right to combine and with the investigation and settlement of labour disputes; documentary quotations and summary tables are included. Chapter IV describes the Ahmedabad Textile Labour Association, to the methods of which is attributed the comparative freedom of Ahmedabad from serious stoppages such as Bombay has frequently suffered. The next chapter is on "Trade Union Co-ordination," and the sixth and last, "Miscellaneous Remarks," discusses, among other topics, India and the International Labour Office, strikes and their causes, conciliation, and communism. It is observed that the communist influence is steadily growing, and is likely to become a serious menace if the employers and employees do not make a serious attempt to understand each other.

Appendices give the text of the Indian Trade Union Acts (1926 and 1928), of the Trades Disputes Act (1929), and of the Bombay Trade Disputes Conciliation Act (1934).]

Sasek (Ivo). Les Migrations de la population intéressant le territoire de la Tchécoslovaquie actuelle (depuis de XVII^e siècle à nos jours). Genève: Naville, 1935. 9½" × 6½". 174 pp. 5 frs. (Swiss).

[A study by a Czech official of the International Labour Office, undertaken in order to expose the nature of the population problem in his country. The first part of the book is concerned with pre-war migration, which falls into two periods: the first (1620-1781) of emigration for religious reasons; the second, corresponding to the nineteenth century, during which both internal migration and the flood of emigration arose from economic causes. Part II treats of migration since the establishment of the State of Czechoslovakia. The movement was at first inward. Czechoslovak legionaries and other former emigrants returned in large numbers from the United States and other countries, and political refugees came from Russia and Hungary. But pressure of population, engendered and continually intensified by a large natural increase, caused the outward flow to begin again. It almost ceased when the world depression put an end to the capacity of other countries to receive the emigrants, but will recur with new opportunities. Meanwhile Czechoslovakia, when the book was written, had half a million unemployed, and the author urges the Government to plan the national economy in order to arrive at a balance between the number of the people and the means of subsistence. The possibilities are rather sketchily discussed in the last chapter. The book includes many tables, a list of sources, and a bibliography.]

STATISTICAL NOTES.

1. BRITISH OFFICIAL STATISTICS.

ON p. 202 we give our usual table summarizing the overseas trade of the United Kingdom for the years 1934 and 1935. The excess of imports over exports of merchandise has shown alternate increases and decreases since the tariff came into operation; in 1933 a decrease of £28 million, in 1934 an increase of £26 million, and last year a decrease of £8½ million to £275·8 million. The decline in the import excess in 1933 resulted from a reduction in imports, exports remaining substantially unchanged, but the subsequent changes have been due to differential movements in the all-round expansion of imports, exports and re-exports. There was in the early part of 1934 a marked expansion in imports of raw materials and of manufactured goods used for further manufacturing in this country; the expansion in the export trade followed at a later date. Comparing each half-year with the corresponding period a year earlier, the excess of imports increased by £24 million during the first half of 1934 and by £2 million during the second half, decreased by £19½ million in the first half of 1935, largely owing to there not being such a heavy importation of raw materials as a year earlier, and increased by £11 million in the second half of last year, when once again imports of materials for industry were heavy. For the whole year imports increased in value by 3½ per cent. and re-exports by 8 per cent. to the highest figures, £756·9 million and £55·3 million, respectively, recorded since 1931, while exports of United Kingdom goods expanded by 7½ per cent. to £425·9 million, the highest figure recorded since 1930.

The increase in exports of United Kingdom goods last year was somewhat less regular than it had been in the preceding year, as is indicated by the following figures showing the average monthly increase throughout each year compared with a year earlier.

Average Export.				Increase in 1934.	Increase in 1935.
				£ million.	£ million.
January-February	...	...	..	2·3	4·0
March-April	...	...	...	2·1	2·9
May-June	...	...	...	2·8	1·6
July-August	...	...	...	2·2	3·0
September-October	...	...	...	2·2	1·6
November-December	...	...	...	2·8	1·9

Following an increase of £6·2 million in 1934, retained imports of food, drink and tobacco increased last year by £9·4 million to

£343·4 million. This increase was due to price changes, since, expressing the imports of each year in terms of average values recorded for 1930, a decline in volume of about 1 per cent. is recorded in the *Board of Trade Journal* for January 23rd as having taken place. Increases in price were important for wheat and flour, oats, butter, cheese and eggs; there was no appreciable change for beef, bacon, tea and tobacco, while barley, maize, mutton and lamb, and sugar each showed a decline, the very low figure of 5/7d. per cwt. being recorded for raw sugar in August. The expansion in home production of wheat resulting from the Wheat Act caused a reduction in 1934 of 9 per cent. in the retained imports to a figure lower than in any year since 1926: there was a further decrease of 1 per cent. last year to 100·7 million cwts. Retained imports of flour, 8·0 million cwts., were the smallest ever recorded. For maize and feeding stuffs for animals there was a small reduction last year in comparison with the extremely high figures recorded in 1934. Changes as regards beef and mutton and lamb in the aggregate were small, but for bacon a decline of 9 per cent. was recorded following a decline of 16 per cent. in 1934. Fresh fruit and vegetables were imported in larger quantity than ever before, practically all descriptions showing an increase on 1934.

Retained imports of raw materials last year, valued at £182·8 million, exceeded those in 1934 by just £1 million. With no appreciable change in average values as a whole, the increase in volume was likewise less than 1 per cent. The expansion in raw materials begun in 1932 was very rapid in the early part of 1934, and showed a rapid movement also towards the end of 1935, the imports during the last quarter of the year exceeding those in any quarter for more than fifteen years, apart from the abnormal quarters in 1926-27, when coal was being imported. Compared with 1934, sheep's and lambs' wool increased by 14 per cent. to the highest figure recorded since 1922, cotton showed no appreciable change, copra and groundnuts were imported in record quantities, retained imports of cottonseed were the highest for 25 years and of wet hides the highest since the war, and imports of silk in the aggregate, of rubber and of wood-pulp were only exceeded by those in 1934.

There was a substantial increase of £10·9 million (6·7 per cent.) in the value of retained imports of articles wholly or mainly manufactured, about one-third of the increase being attributable to price changes. This increase followed an increase of 15 per cent. in the previous year and, like that, was very largely in goods used as materials for industry. Imports of unwrought copper in 1934 were larger than in any earlier year, but this total was exceeded in 1935 by 20 per cent.; there was an increase also in the other non-ferrous

metals, and the total increase in value of the retained imports was £3.2 million—exports of non-ferrous metals and manufactures expanded in a like degree, the value increasing by £2.2 million. Machinery imported, a considerable part of which consists of descriptions not manufactured in this country, increased by £1.9 million. Imports of crude iron and steel and of rolling-mill products were reduced, an agreement being concluded with the Continental Steel Cartel in the middle of the year. Retained imports of refined petroleum, 2,259 million gallons, constituted a record for the third successive year. Descriptions other than motor spirit declined, but for motor spirit there was an expansion of 10 per cent. to 1,207 million gallons. Deducting bunker shipments of imported fuel oil, an increase of 20 per cent. in the quantity of fuel oil retained for home consumption is seen to have occurred. Among other goods, there was a marked increase in imports of plywood, of cotton goods in the grey, the latter being probably goods for processing in this country, and of motor-cars, but most of the finished goods were imported in about the same quantities as in 1934.

The quantity of coal exported, which in 1934 had shown an increase, declined last year by $2\frac{1}{2}$ per cent. to 38,714,000 tons, the lowest figure since 1926. The principal changes were an increase of 1,028,000 tons in exports to the Irish Free State, resulting from the coal-cattle agreement, and declines of 1,509,000 tons in exports to Italy and of 540,000 tons in exports to France. The value of the coal exported represented only 7.4 per cent. of the total value of British exports, the proportion having declined year by year from 8.9 per cent. in 1931. Exports of iron and steel, which had shown a marked improvement in 1934, expanded again last year, the total (2,372,000 tons) being higher than in any year since 1930. The increased exports were taken principally by India and South Africa. The Board of Trade have calculated that adding together the value of the exports of iron and steel and manufactures thereof, "iron ore and scrap, cutlery, hardware, tools, machinery and vehicles (except rubber tyres), the contribution to the total value of British exports was 24.1 per cent. in 1929, 21.8 per cent. in 1933, 23.8 per cent. in 1934, and 25.8 per cent. in 1935." The rising proportion in recent years was due primarily to the expansion in exports of machinery, though vehicles have likewise increased in importance. The number of motor-cars and chassis exported constituted a record for the third year in succession, and a record number of pedal cycles were exported. Exports of locomotives and rolling stock and of ships and boats showed some recovery from the low figures recorded in recent years.

Movements and Classes.	Twelve Months ended Dec. 1934.	Twelve Months ended Dec. 1935.	Increase (+) or Decrease (-).			
Imports, c.i.f.—	£'000.	£'000.	£'000.			
Food, drink and tobacco	346,589	355,956	(+) 9,367			
Raw materials and articles mainly un- manufactured	209,506	211,758	(+) 2,252			
Articles wholly or mainly manufac- tured	171,366	185,132	(+) 13,766			
Other articles	3,953	4,090	(+) 137			
Total Imports ...	731,414	756,936	(+) 25,522			
Exports, f.o.b.—						
<i>United Kingdom Produce and Manufactures—</i>						
Food, drink and tobacco	30,454	31,638	(+) 1,184			
Raw materials and articles mainly un- manufactured	48,258	52,799	(+) 4,541			
Articles wholly or mainly manufac- tured	304,841	328,937	(+) 24,096			
Other articles	12,433	12,548	(+) 115			
<i>Imported Merchandise—</i>						
Food, drink and tobacco	12,638	12,565	(-) 73			
Raw materials and articles mainly un- manufactured	27,673	28,914	(+) 1,241			
Articles wholly or mainly manufac- tured	10,625	13,503	(+) 2,878			
Other articles	307	283	(-) 24			
Total Exports ...	447,229	481,187	(+) 33,958			
Bullion and Specie—						
Imports	284,670	284,518	(-) 152			
Exports	141,261	228,932	(+) 87,671			
Movements of Shipping in the Foreign Trade—	Number of Vessels.	Thousand Tons Net.	Number of Vessels.	Thousand Tons Net.	Number of Vessels.	Thousand Tons Net.
<i>Entered with cargoes—</i>						
British	24,144	36,130	24,348	36,110	(+) 204	(-) 20
Foreign	25,071	26,541	24,580	27,519	(-) 491	(+) 978
Total entered ...	49,215	62,671	48,928	63,629	(-) 287	(+) 958
<i>Cleared with cargoes—</i>						
British	28,415	33,799	29,306	34,302	(+) 891	(+) 503
Foreign	21,149	22,291	21,087	23,020	(-) 62	(+) 729
Total cleared ...	49,564	56,090	50,393	57,322	(+) 829	(+) 1,232

As regards textiles, it is stated in the *Board of Trade Journal* that "in 1929 textile exports formed 31.3 per cent. of the total value of British exports, but this proportion has been lower in recent years, being 28.7 per cent. in 1933, 28.3 per cent. in 1934, and 27.5 per cent. in 1935. Cotton exports, which formed 18.7 per cent. of the total in 1929, fell to 16.1, 15.1 and 14.4 per cent. in 1933, 1934, and 1935, respectively. Exports of wool and manufactures thereof have formed an increasing proportion during the last three years—8.4, 8.8 and 9.1 per cent., respectively; in 1929 the proportion was 8.6 per cent." Exports of cotton yarns were the largest since 1929, but piece-goods declined further from 1,994 to 1,949 million square yards, being the lowest for many years, apart from 1931 when exports to India were abnormal. The decline in exports of piece-goods last year was spread over practically all the principal markets, but exports to British West Africa increased to a total higher than for any earlier year. Exports of sheep's and lambs' wool constituted a record; wool tops were exported in larger quantity than in any year since the war, woollen and worsted tissues since 1930, and carpets since 1929, but a decline was recorded for woollen and worsted yarns. Linen piece-goods were slightly less than the high total for 1934. A considerable expansion was recorded for silk piece-goods, jute piece-goods, sacks and bags, and cordage, but exports of artificial silk piece-goods were lower than in 1934 or 1933.

Among other goods, exports of nickel were the largest ever recorded, and of copper and manufactures thereof the largest since 1923. An appreciable expansion in comparison with the figures for each of the two preceding years was shown by pottery, hats, sodium compounds, paints and colours, leather, and books, and exports of electrical goods and apparatus have increased in value each year since 1932. On the other hand, declines were recorded for leather boots and shoes and ammonium sulphate. There was no substantial change in exports of spirits or tobacco.

Reference has been made above to the effect of price changes on the recorded values of the separate classes of retained imports. For exports, changes in average values tended to be smaller, the largest being a decline of 3 per cent. for food, drink and tobacco. For the aggregate, average values of exports of United Kingdom goods were within one-half of 1 per cent. of the figures for 1933 or 1934, imports increased in average value last year by 2 per cent. and re-exports declined by 5 per cent. Eliminating price changes, imports expanded in 1935 by 2 per cent., exports of United Kingdom goods by 8 per cent. and re-exports by $13\frac{1}{2}$ per cent.

Imports of bullion and specie were valued at £284½ million in both 1934 and 1935, but exports increased from £141 million to £229 million. Of the exports last year the United States absorbed £139 million. The year was marked by great activity in respect of silver, due to the United States buying policy. Imports amounted to £40.4 million and exports to £54.9 million, much higher figures than those recorded for any earlier year. In 1934, the movement of silver was also very active, imports being valued at £22.2 million and exports at £12.5 million.

The Final Report on the Fourth Census of Production of the United Kingdom (1930) (pp. vi + 175, 3s.) issued by the Board of Trade towards the end of 1935 summarizes the reports on industries which were given in full in four preceding volumes and provides information on certain subjects which could most conveniently be handled from a general standpoint. In the first chapter the general results are tabulated and calculations are made as to the relative importance of the small firms (employing 10 or fewer persons) excluded from the Census. It is estimated that those small firms contributed about 8 per cent. of the total net output of industry in 1930 and about 7 to 7½ per cent. in 1924. The total net output of the Census trades fell from £1548.6 million in 1924 to £1505.2 million in 1930, and on the basis of conditions as they were in 1924 the latter figure would have been £1674.3 million, so that net output on the basis of 1930 conditions showed a fall of about 10 per cent. Net output per person employed was £212 in 1924 and £211 in 1930. Chapter II deals with number and size of establishments and shows that net output per person employed rose in the factory trades from £200 for establishments with 11-24 employees to £269 for those with 1500 or over, except for a drop to £201 for the 200-299 group; for non-factory trades (chiefly mining, building, and public utilities) the spread of net output among the size-groups was quite irregular. Although a great persistence of the small undertaking is disclosed, the 535 large firms with 1000 or more employees produced 28.2 per cent. of the aggregate net output of factory trades, while 32,040 returns from firms with fewer than 100 employees covered only 22.5 per cent. of that net output; there were in all 42,225 returns from 49,499 establishments in the factory trades.

Chapter III compares the estimates of the movement of production shown in the quarterly index of production with the results shown by the Census. That index showed an average of 103.2 for 1930, 100 representing 1924, while the Census indicated that the volume of production "was 2.9 per cent. higher in 1930 than in 1924 for the items covered by the index," and, though some important

differences were found in the details, the conclusion is that "the series of index numbers from 1927 to 1930 can probably be taken as expressing within a little the actual changes in production which took place during that period in the industries for which particulars are included in the index." It is calculated in Chapter IV that the volume of production in 1930 was 8.1 per cent. above that for 1924; only the groups of textiles, leather, and mines and quarries showed declines and the increases in engineering, timber, public utilities, and building were conspicuous. The next chapter contains some important estimates which may be briefly summarized by saying that the aggregate value at the point of production of the products of industry, agriculture, fishing, and forestry was £2724 \pm 20 million in 1924 and £2457 \pm 20 in 1930, and that the value of British exports, also at the place of production, was £743 \pm 8 million in 1924 and £535 \pm 6 in 1930. "On the basis of the mean figures the exports represented 27 per cent. of the production in 1924 and under 22 per cent. in 1930." Cotton accounted for half the decline in exports and wool and coal for over 21 per cent.

Chapters VI and VII deal respectively with specialization in industry (showing the proportion of firms in different industries whose principal products are specialized) and with the regional distribution of industry (indicating the distribution of production among the three divisions of the United Kingdom and in eleven large industrial areas). Interesting particulars of the growth of industries in the South of England are also given. Chapter VIII deals with employment and in Chapter IX the results of the voluntary wage census taken in 1930 are applied to the data of the Census of Production, yielding totals of £725 million in 1924 and £668.2 million in 1930 for Great Britain, or, after including Northern Ireland and allowing for the excluded small firms, £787 \pm 10 million in 1924 and £734 \pm 10 million in 1930 for the United Kingdom. The following summarized table is instructive :

Average Annual Earnings per Operative.	Number of Operatives Employed.	Approximate Proportion of Totals.	Wages Paid.	Wages as a Proportion of Net Output.
	No.	Per cent.	£100	Per cent.
Up to £100	873,953	68	76,810	52.1
£101-£120	460,503	37	51,748	44.6
£121-£140	769,627	14	100,311	45.7
£141-£160	478,676	15	71,162	45.9
Over £160	59,695	6	12,333	31.6
Total ...	2,642,454	36	312,364	46.1

Chapter X treats of the power equipment of industry, and it may be seen that, while the number of operatives employed fell by 2.9 per cent. between 1924 and 1930 and there was a fractional reduction in the horse-power of prime movers (excluding electricity works in both cases), the horse-power of electric generators at *all* works increased by 58.6 per cent. There was little change in the proportion of prime movers and electric motors recorded as "in reserve or idle" in factories. The last chapter deals with the consumption of coal, coke, and electricity for power and other purposes. Six appendices elaborate details of certain subjects discussed in the text.

While the *Final Report on the Fourth Census of Production* is important as providing a picture of the industry of the United Kingdom as it was descending into depression, Part I of the *Report on the Import Duties Act Inquiry* (1933) (pp. xii + 329, 5s.), also issued by the Board of Trade, provides a partial record of the state of affairs as the country was emerging from the slump. The trades included in this volume are the textile trades, the leather and clothing trades (except tailoring, etc.), the food trades, the chemical and allied trades, and sundry miscellaneous trades. "The scope of the Enquiry was designed to correspond as closely as possible with that of the 1930 Census." In the textile trades covered the number of persons employed declined between 1930 and 1933 from 1,045,140 persons to 1,009,612 and net output from £145.1 million to £143.2 million, but net output per head increased from £139 to £142; the volume of output increased in all trades except lace, ropes, canvas, asbestos, and coir, the largest increase, 34 per cent., being in hosiery. The leather and clothing trades, for the same period, showed persons employed down from 201,460 to 198,764, net output down from £36,058,000 to £32,577,000, and net output per head down from £179 to £164; there were modest increases of 3 to 8 per cent. the volume of production in leather, leather goods, boots, and hats, an increase of 19 per cent. in gloves, and a heavy fall in umbrellas. Grainmilling, biscuits, preserved foods, dairy products, and cattle foods show brighter results, employees having increased from 123,383 to 133,243, net output from £39.3 million to £43.1 million, and net output per head from £319 to £323; the volume of production was greater by 10 per cent. in milling but only by 2 per cent. in dairy products, the other trades showing satisfactory increases.

The ten groups of chemical and allied trades show a small decline in employees, from 167,719 to 164,808, but net output rose by £4

million to £69.6 million and net output per head increased from £391 to £422; the main group of chemicals, dyestuffs, and drugs shows a 21 per cent. increase of volume and the others (except paints and ink, etc.) varying additions. The nine miscellaneous trades all give increases in volume except two. The principal trade included was rubber which recorded a 15 per cent. increase in volume coupled with small declines in employees and in net output, but a fall in net output per head from £278 to £268. The second most important trade was coke with a 21 per cent. drop in volume, a decline in employees from 15,325 to 11,477, and a heavy fall in net output from £3.5 million to £2.6 million, but net output per head was only reduced from £229 to £228.

It has often been said of tariffs that they produce interesting statistics, and in this case manufacturers were required to furnish particulars of the principal materials used, a power not granted to the Board of Trade under the Census of Production Act. For example, we now learn that the cotton weaving trade used 802.9 million lbs. of cotton yarn, the hosiery trade 60 million lbs., the lace trade 13.7 million lbs., the elastic webbing trade 4.6 million lbs., and the rope trade 665,000 lbs. Curiously enough there does not appear to be a materials table for the woollen and worsted trades or for the silk and artificial silk trades.

The general level of *wholesale* prices as measured by the new Board of Trade Index-Number (averages for the year 1930 = 100) showed a rise in 1935 of 0.9 per cent. above that of 1934. It was higher than in any year since 1930, but was still 11.1 per cent. below the level of that year, and as much as 22 per cent. below the level of prices in 1929. The advance in the average prices of food and tobacco in 1935 as compared with 1934 was 1.9 per cent., but in those for materials and manufactures it was only 0.4 per cent. The index number for chemicals and oils rose 4.1 per cent., that for non-ferrous metals 3.6 per cent., and that for iron and steel 1.8 per cent. There was also a rise of 4.2 per cent. for textiles other than cotton and wool, but this was chiefly due to the great advance in the price of hemp, which rose as much as 90 per cent., between April and December, 1935. The rise in the prices of iron and steel has been practically continuous since 1932, and in December, 1935, the index number (102.1) had advanced $12\frac{1}{2}$ per cent. above that for June-September, 1932 (90.8). On the other hand, the index-numbers for cotton and wool were lower in 1935 than in 1934. The prices, however, for both cotton and woollen yarns and cloths advanced somewhat during the last few months of 1935, and raw

wool in December, 1935, was as much as 27 per cent. higher in price than in December, 1934.

As compared with a year ago, the high prices of bacon have receded to some extent, and prices of butter have advanced, especially New Zealand butter. The most noticeable advance in the prices of articles of food was in the case of potatoes, which in December, 1935, was 54 per cent. above the price in the previous December, an advance due to the partial failure of the home crop. As regards materials, lead has advanced 52 per cent., zinc 29 per cent. and copper 26 per cent. There has been some decline in the high prices for tin obtained in the first seven months of the year. The general index-numbers for basic materials, intermediate products and manufactured articles respectively show little change between 1934 and 1935, but there has been a hardening of the prices for building materials in general throughout the year.

The index-numbers from July, 1935, are given below.

Averages for 1930 = 100.*

Period.	Total Food.	Total not Food.	All Articles.	Basic Materials.	Inter-mediate Products.	Manu-factured Articles.	Building Materials.
July 1935 ...	84.7	89.7	88.0	88.1	87.5	94.7	93.8
Aug. „ ...	85.6	89.8	88.4	88.2	87.6	94.8	94.2
Sept. „ ...	87.8	90.4	89.6	89.7	87.9	94.9	94.6
Oct. „ ...	89.3	92.0	91.1	92.0	88.9	95.8	95.1
Nov. „ ...	88.1	92.8	91.2	94.6	89.6	96.1	95.3
Dec. „ ...	88.5	92.9	91.4	93.8	90.0	96.2	95.1
Year 1935 ...	86.6	90.1	88.9	88.3	87.6	91.9	93.8
„ 1934 ...	85.0	89.7	88.1	88.0	86.9	94.8	92.6
„ 1933 ...	82.9	87.2	85.7	80.2	84.6	93.5	92.5

* The index-numbers based on the averages for the year 1913 and for the year 1924 are not now calculated at the Board of Trade.

The figures for certain of the British Index-Numbers and the official index-numbers for Germany, France and the United States are given below, the average prices for 1913 being taken as 100 for all the index-numbers except that of the Board of Trade.

Date.	Board of Trade (1930 = 100).	Econ-omist.	Statist.	The Times.	France (Stat. Gen.).	Germany (Stat. Reichsanst.).	United States (Bureau of Labor).
Dec. 1934 ...	87.8	90.4	97.4	100.6	344	101.0	110.2
July 1935 ...	88.0	93.7	99.2	102.9	322	101.8	113.8
Dec. 1935 ...	91.4	98.2	102.0	107.5	354	103.8	115.4

It will be seen that there has been an appreciable rise in all the index-numbers over the twelve months, and that the rise has generally been more pronounced during the latter half of 1935.

The general level of *retail prices* in Great Britain of articles of working-class consumption was in 1935 somewhat higher than in 1934. The increase was chiefly due to a rise in food prices, but there was a slight advance early in the year in the level of rent and rates owing to increased rates in a number of localities. As measured by the index-number of the Ministry of Labour food prices experienced the usual seasonal fall in the spring, but advanced to a greater extent than usual in the latter end of the year, and at January 1, 1936 the index-number for food has increased to 131 (July, 1914 = 100) compared with 125 at January 1, 1935. The index-number for rent and rates rose during the same period from 156 to 158. Taking all items of expenditure together, however, the index-number for 1935 only showed an advance of less than $1\frac{1}{2}$ per cent. on that for the year 1934 (141 to 143). The partial failure of the British potato crop has raised the price to 20 per cent. above that obtaining a year ago, and the seasonal advance in the price of eggs has been somewhat higher this winter. Bread is 7 per cent. dearer than a year ago and butter and cheese are somewhat higher in price, but both butter and margarine are still below the level of July, 1914, and cheese only slightly dearer. The index-numbers for recent months are given below (prices at July 1, 1914 = 100).

	July, 1, 1935.	Aug. 1, 1935.	Aug. 30, 1935.	Oct. 1, 1935.	Nov. 1, 1935.	Nov. 30, 1935.	Jan. 1, 1936.	Jan. 1, 1935.
Food Prices ...	126	126	125	128	131	131	131	125
All Items (food clothing, rent, fuel, etc.) ...	143	143	143	145	147	147	147	143
<i>All Items</i> <i>(a year earlier)</i>	141	142	143	143	144	144	143	142

The net effect of all the *changes in wages* reported to the Ministry of Labour in 1935 was an increase of £187,500 in the weekly full-time rates of wages of the workpeople affected.* This is only the second year since 1926 in which a net rise has occurred, the year 1934 being the first. The industries chiefly affected by the changes were the metal and engineering trades, the building trades, brick-making and textile bleaching and dyeing. Although not included in the figures, increases took place in 34 counties in England and Wales in the minimum rates of wages of agricultural labourers, which are fixed under the Agricultural Wages (Regulation) Act of 1924, and there was a slight increase in the wages of agricultural labourers in Scotland. The Ministry of Labour estimates that in

* Excluding changes in the wages of agricultural labourers, domestic servants, Government employees, shop assistants and clerks.

all the industries (including agriculture) for which information is available the average level of full-time weekly rates of wages rose about 1.5 per cent. during 1935.

About 36,000 workpeople had their *working hours reduced* in 1935, and the average reduction was rather less than 3 hours per week.

The aggregate number of working days lost in 1935 at establishments where *trade disputes* occurred amounted to 1,920,000, or about double the number of days lost in 1934. The net number of workpeople involved was about 220,000, although some of these were on strike more than once. Of the total number 143,000 were coal miners, and the time lost in these disputes amounted to 1,333,000 working days, or 69 per cent. of the total working time lost.

In the *Agricultural Statistics* (Part I, 1934) issued by the Ministry of Agriculture, an estimate is made which puts the total value of the agricultural output of England and Wales in 1933-34 at £201,750,000 compared with £184,830,000 in the preceding year, an increase of 9 per cent. The rise in the total value is said to be due in part to an expansion in the production by quantity of a number of commodities, and also in certain cases to higher average prices. Taken together, these two factors led to a recovery in the value of the agricultural output almost to the level of the year 1930-31. This, moreover, is exclusive of the payments made by the Wheat Commission, which in the cereal year 1933-34 amounted to £7,180,000.

The index number of the *prices of agricultural produce* in England and Wales calculated by the Ministry of Agriculture for the period known as the "harvest year" (which makes a better allowance for seasonal fluctuations than the calendar year) showed a slight increase in the twelve months ending August, 1935, the figure being 115 as compared with 113 in 1933-34. If the deficiency payments under the Wheat Act and the Cattle Industry Act are taken into account, the index number is raised by 6 points to 121. This is nearly equal to the ordinary index number for 1930-31.

The figures given below show the general index and the revised index including these additional payments (base 1911-13 = 100) :—

	1929-30.	1930-31.	1931-32.	1932-33.	1933-34.	1934-35.
(Revised) ...	139 —	125 —	114 —	106 110	113 117	115 121

It will be seen that although the tendency to rise shown by general index number in 1933-34 was continued into 1934-35, the movement in the latter year was very small.

In continuation of previous tables (*Journal*, Part III, 1935, p. 580) the monthly index numbers of agricultural prices from June to December 1935 and earlier years are given below :—

		June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1935	...	111	114	113	121	113	113	114
1934	...	110	114	119	119	115	114	113
1933	...	100	101	103	107	107	109	110
1932	...	111	106	105	104	100	101	103
1931	...	123	121	121	120	113	112	117

The index in the last three months of 1935 became almost stationary, and showed little variation as compared with the corresponding months of last year. The rise in the month of September was due almost entirely to a rise in the wholesale contract price of milk as compared with the base period.

Unemployment declined generally and on the whole continuously during 1935, and the number of unemployed persons on the registers of the employment exchanges at December 16, 1935, was lower than at any date since June 23, 1930. The average rate of unemployment in the insured trades during the year in Great Britain and Northern Ireland was 15·6 per cent., compared with 16·7 per cent. in 1934, 19·9 per cent. in 1933, 22·1 per cent. in 1932, 21·3 per cent. in 1931, and 16·1 per cent. in 1930. In 1929 the rate was 10·4 per cent., and in 1927, 9·7 per cent., and it was lower in these two years than at any time since December, 1920. In all districts employment was better than in any year since 1930. The proportion unemployed, however, was as high as 31·2 per cent. in Wales, 21·3 per cent. in Scotland, 20·7 per cent. in N.E. England, and 19·7 per cent. in N.W. England. It was lowest in London and in the South-Eastern District, where the average yearly rates were 8·5 and 8·1 per cent. respectively. In the Midlands it was 11·2 per cent. and in the South-Western District it was 11·6 per cent.

In all the 102 groups into which the Ministry of Labour divides up the insured trades employment was better in December, 1935, than at the same date in 1934, except in industries covering less than 500,000 workpeople, and in these the increase in unemployment is slight and less than one-half per cent. Nevertheless, in industries covering more than a million and a half workpeople the rate of unemployment at December, 1935, was over 20 per cent.,

reaching as high as 47·6 per cent. in public works contracting, and 37·2 per cent. in shipbuilding and ship repairing. Unemployment was lowest among makers of scientific and photographic apparatus (3·7 per cent.), commerce, banking, etc. (4·4 per cent.), paper and printing trades (6·8 per cent.), and makers of chemicals, soap, paint, etc. (8·6 per cent.).

The industries showing the most marked improvement in 1935 were building, woollen textile, engineering, and iron and steel trades. There was also an appreciable improvement in the boot and shoe, hosiery, and printing and paper trades, and in practically all the metal trades except tinplate manufacture.

The average number of insured persons employed in 1935 was about 10,371,000, a number higher than in any previous year. The next highest average—in 1929—was 10,220,000.

The number of workpeople (insured and uninsured) on the registers of the employment exchanges of the Ministry of Labour in Great Britain are given in the following table for July–December, 1935.

Date.	Wholly Unemployed.	Temporarily Stopped.	Persons Normally in 'usual Employment.	Total.
July 22, 1935 ...	1,501,226	393,198	78,517	1,972,941
Aug. 26, „ ...	1,533,259	334,419	80,286	1,947,964
Sept. 23, „ ...	1,576,425	298,845	83,340	1,958,610
Oct. 21, „ ...	1,595,689	238,866	81,835	1,916,390
Nov. 25, „ ...	1,617,237	221,443	79,882	1,918,562
Dec. 16, „ ...	1,585,990	205,574	77,001	1,868,565
Dec. 17, 1934 ...	1,717,005	288,257	80,553	2,085,815
„ 18, 1933 ...	1,830,977	308,821	84,281	2,224,079
„ 19, 1932 ..	2,171,175	454,522	97,590	2,723,287 *

* Highest figure in any December.

The above figures now include juveniles aged 14 and 15 who are on the live registers of the Exchanges. At December 16, 1935, these numbered 20,339 (10,864 boys and 9,475 girls).

Employment in Germany improved appreciably during the year 1935, and was better throughout than in the corresponding months of 1934, although at the end of December the number reported as unemployed (2,506,800) approached more nearly to the number reported in December, 1934 (2,604,700). At the end of December, 1935, about 1,408,600 of the total unemployed were in receipt of standard or emergency benefit and 376,000 were in receipt of poor relief. It is still not quite clear whether the numbers reported

exclude those on voluntary labour service and on relief works. Employment in France declined in 1935, and the numbers remaining on the registers of employment exchanges at the end of each month were greater than at the corresponding dates in 1934. At December, 1935, the number was 481,100. The monthly investigation into undertakings employing over 100 workpeople each show also a decline in employment in 1935 compared with each month of the previous year. In Belgium employment improved during the last reported six months of 1935, but in Holland there was an appreciable decline, the rate of unemployment during the twelve months ended November, 1935, among the half a million members of the Unemployment Funds averaging 28.5 per cent. compared with 25.6 per cent. on the previous twelve months. In the Scandinavian countries employment improved during the year, but unemployment was still severe, the average proportion unemployed in trade unions during the latest twelve months being 14.9 per cent., 23.5 per cent., and 19.9 per cent. for Sweden, Norway, and Denmark respectively. No recent statistics are available for Italy, but up to September last employment had improved very considerably compared with the previous twelve months. Employment in Austria improved compared with 1934, and in Poland, though worse in the first six months of the year, there was some noticeable improvement later. In Czechoslovakia employment was appreciably worse than in 1934 towards the end of the year.

Unemployment in the United States remains very considerable, although not so high as in 1933 and 1934. It is difficult, however, to arrive at any very exact measure of the total unemployment. The American Federation of Labour estimates that the number of unemployed persons in October, 1935, was 11,647,000 (inclusive of about 3,000,000 engaged on relief work schemes), as compared with 15,740,000 in March, 1933. The Federation also estimates that in 1929 immediately preceding the depression the number unemployed averaged 1,938,000. The National Industrial Conference Board puts the number at the same date as 9,196,000 and at March, 1933, at 13,300,000. Another estimate made by Mr. Robert R. Nathan, at one time consultant on unemployment statistics to the President's Committee on Economic Security, puts the number in September, 1935, at 10,915,000, or a reduction of 4,156,000 from his estimate for March, 1933. The Federal United States Employment Service has since the end of 1934 published the number of persons remaining on the registers of their exchanges at the end of each month. The number was as low as 6,094,000 at the end of May last, but there has been a considerable increase since, owing to the fact that registration at a public employment exchange is now

a condition for employment on most relief works. At the end of September the number remaining on the registers was 8,697,000.

Return No. 190 of the *Railway Statistics* issued by the *Ministry of Transport* states that during the first nine months of 1935, the total number of passenger journeys (excluding season tickets) on the main-line railways of Great Britain was 650,220,000, an increase of 20,263,000 or 3·2 per cent. over the corresponding period of 1934. The passenger receipts at £37,714,000 were £1,198,000 or 3·3 per cent. above the 1934 figure. Approximately 90 per cent. of the journeys were at fares below the standard, the receipts per journey remaining practically the same as in 1934 at 13·9d.

In addition, the railway undertakings of London Transport accounted for 288,178,000 journeys, a figure in excess of 1934 by 20,668,000 or nearly 8 per cent., principally due to the influx of Jubilee visitors. The receipts for this section were £3,879,000, an increase of £221,000 or 6·0 per cent., the average receipts per journey being 3·2d.

Season ticket revenue on the main-line systems yielded £6,386,000, or £108,000 above 1934, and parcels and miscellaneous traffic by passenger trains rose slightly to £9,530,000. Increased travel in the London Area is also indicated by the Transport Board's receipts from season tickets which were £25,000 higher at £920,000.

Freight traffic carried during the first forty weeks of the year was 2,554,000 tons, or 1·2 per cent. lower at 204,393,000 tons, and receipts fell by £345,000 or 0·5 per cent. This was largely due to decreased coal traffics, which are likely to have recovered to some extent during the closing months of the year.

The operating statistics indicate that additional expenditure has been necessary to deal with the heavier passenger traffics, coaching engine mileage having risen by 2·1 per cent. to 262,613,000. A reduction of 13·2 per cent. in the mileage of assisting engines is no doubt largely due to the utilization of more powerful locomotives. Freight train mileage at 185,503,000 has fallen to approximately the same extent as the receipts, being 859,000 miles or 0·5 per cent. lower.

An all-round improvement in train speeds is shown, coaching train miles per hour (including all standing time) having risen by 0·7 per cent. to 15·23. The corresponding freight figure is 1·8 per cent. higher at 9·55. The average net load of freight trains was slightly lower at 123·90 tons, but the greater speed of working resulted in the net ton mileage per engine hour increasing by 0·8 per cent. to 462.

The return also gives detailed revenue statistics for each company in respect of the month of September and operating results for the

four-weeks ended 5th October. An additional table is included relating to operating statistics in the principal marshalling yards.

All companies show increases in gross receipts during the 52 weeks ended 29th December, the aggregates being as follows :—

				Increase on 1934.	
				£	Per cent.
Great Western	...	...	25,267,000	274,000	1.1
L.M.S.	...	...	60,683,000	891,000	1.5
L.N.E.	...	...	44,601,000	198,000	0.5
Southern	...	...	20,246,000	188,000	0.9
Total	...	...	£150,797,000	£1,551,000	1.0
London Transport	...	..	£14,146,000	£204,000	1.5

2. OTHER STATISTICS.

At the end of August, 1935, the League of Nations published a survey of *World Production and Prices* (Allen & Unwin, 5s.) in continuation of an annual series of similar reports. Even after taking into account all the unavoidable deficiencies, the reliability of Mr. Loveday's compilation is now well established, and for the benefit of new-comers it is only necessary to say that it summarizes all available information in three groupings: world production, international trade and shipping, and price movements. The first of these is subdivided into primary production (agricultural and industrial raw materials), industrial production, and a review of the chief branches of primary and manufacturing production. The second part shows the quantum changes in international trade, and is a brief sketch of what is handled more fully in the annual *Review of World Trade*. The third part includes the movements of the general price level and of the prices of individual commodities, and displays the relations—or want of relation—between the prices of different kinds of goods. Further details beyond those used in the text are given in a series of tabular appendices. In brief, the world's industrial activity, which (on the basis of average 1925-9 = 100) had fallen from 112 in 1929 to 78 in 1932, recovered to 96 in 1934, and the world trade-quantum, which had fallen from 110 to 81, rose again to 86. Correspondingly, the production of industrial raw materials also rose, but agricultural production, which had continued rising to 104 in 1933, fell to 101 in 1934. Japan shows the most striking advance in industrial production, but the United Kingdom and other countries "off gold" also advanced, while the

gold bloc countries and the United States do not show up well. The gold value of international trade in 1934 was only 35.6 per cent. of the average of 1925-9, but the quantum of goods entering into international trade in 1934 had recovered to 85.5 per cent. of the 1925-9 average from the low point of 81 per cent. in 1932. Changes in price levels were comparatively slight in 1934, and some of the major discrepancies developed during the depression were mitigated in 1933 and up to the spring of 1935.

The values of *Stock Exchange Securities*, as measured by the index-number of the *Bankers' Magazine*, showed little change on the whole at December 20, 1935, compared with December 17, 1934. Over the year, however, there had been a fall of about 2.4 per cent. in Fixed Interest Stocks and a rise of 5.8 per cent. in Variable Dividend Securities. The largest fluctuation during the year was when the Abyssinian crisis was at its most acute stage, and in the month ending September 20 the index-number fell 4.1 per cent., both types of securities sharing almost equally in the fall. By the middle of December, however, Fixed Interest Stocks had almost entirely gone back to their level at the middle of August, while Variable Dividend Securities were as much as 2.2 per cent. above that level. These latter are now at a higher level than at any time since November, 1930. Copper-mining shares were a notable exception to the general fall in September, and the value of these has continuously appreciated, until at December 19 they were 23 per cent. above the level of the value at August 1935. The index-numbers (December, 1921 = 100) for the months July to December, 1935, are given below.

Date.	Fixed Interest Stocks	Variable Dividend Securities.	Total.
July, 1935... ..	131.5	115.6	126.4
August 19, 1935	129.8	117.5	125.8
September 20, „	124.3	112.7	120.6
October 18, „	125.5	112.6	121.3
November 19, „	128.9	118.3	125.3
December 16, „	129.5	120.1	126.4
December, 1934	132.7	113.5	126.5
„ 1933	122.0	108.4	117.6
„ 1932	116.1	95.8	109.4
„ 1931	102.2	90.7	98.5

The rates obtained for *shipping freights* in December, 1935, were nearly 19 per cent. higher than for December, 1934, and rather more than 7 per cent. higher than for November, 1935. Owing,

however, to the lower rates obtained in the first three months of 1935, and also in August and September, the general average for the year shows but a slight improvement on that for the previous twelve months. The index-number compiled by the Chamber of Shipping for the year 1935 was 18.97 (1920 = 100), while that for 1934 was 18.86. In December, 1935, the number was 22.49 and in December, 1934, 18.90. Minimum freight schemes were in operation throughout the year in trades for Australia, the Argentine, Canada and the United States, and were reported to be working satisfactorily. Rates in these trades were stated to be on a higher basis than in other trades. A minimum freight scheme for the Baltic and White Sea timber trade was started about the middle of December, 1935. Under the subsidy scheme for tramp shipping, if the average level of freights for the year rose to 93 per cent. of the level in 1929, a reduction of one-eighth in the amount of the subsidy, with similar reductions as the percentage rose, would have taken place. In 1935, however, average freights were only 76.3 per cent. of those in 1929.

The returns relating to *retail sales* in Great Britain, prepared by the Association of Retail Distributors in conjunction with the Bank of England, show the relation of sales month by month in 1935 to the sales in the corresponding periods of 1934. Figures at present available relate to the eleven months February to December, 1935, and these show that the total sales during the ten months amounted to 6.1 per cent. more than in the same months of 1934. Sales of food and perishables had increased 7.6 per cent. and other articles 4.5 per cent. Some portion of the increased sales of food has been due to the advance in prices, but the Ministry of Labour index-number of retail prices of food increased during the corresponding periods rather less than 2 per cent. The sources of the two sets of figures vary appreciably, but on the whole it would appear that there has been an increase in the *amount* of the sales which may well be as much as 5 per cent. The total number of persons employed in the establishments reporting sales was 3.3 per cent. more at the end of December, 1935, than a year earlier. The index-number representing sales in December, 1935, was 146 (average value of daily sales in 1933 = 100). The number for December, 1934, was 108, and for December, 1933, 131.

In connection with the allowances payable to growers under the Wheat Act, the Report of the Standard Price Committee points out

that under the Act the quantity of home-grown millable wheat ranking for the full deficiency payment is limited to 27,000,000 qrs. If more home-grown wheat is sold, the deficiency payment is correspondingly reduced, so that the standard price of 10s. per cwt. or 45s. per qr. laid down in the Act is not in fact realized. It appears from returns issued by the Wheat Commission that the total quantity of wheat sold in 1934-35 amounted to just under 36,000,000 qrs., so that the deficiency payment of about 5s. per cwt. which would have been paid on 27,000,000 qrs. was reduced by one-third, with the result that farmers who realized the average market price for their wheat (*i.e.* 4s. 10 $\frac{3}{4}$ d. per cwt.) secured in the aggregate not 45s. per qr., but about 39s. 1d. per qr. In this way, the mechanism of the Wheat Act limits the likelihood of over-production or the growing of wheat upon land unsuitable for the purpose. The farmers' receipts from wheat are also brought nearer to parity with the receipts from other crops.

Reference may here be made to an interesting article by Murray and Cohen of the Oxford Agricultural Economic Research Institute (*Scottish Journal of Agriculture*, Oct. 1935), giving the result of a statistical study of the relationship between the purchasing power of wheat in terms of other commodities and the acreage planted in Great Britain in each year since 1904. This analysis suggests that under present conditions 1,800,000 acres is about the area likely to be planted when wheat prices are in the neighbourhood of 9s. per cwt., though further progress in wheat-production methods as compared with other lines of production might lead to a higher acreage. Actually the area of wheat in Great Britain in 1935 according to the preliminary returns was 1,872,000 acres, while the average wheat price (made up of the market price of 4s. 10 $\frac{3}{4}$ d. and the subsidy of 3s. 9 $\frac{1}{2}$ d.) was 8s. 8d. per cwt., *i.e.* 39s. per qr.

The International Institute of Agriculture, in its monthly Crop Report for October, 1935, makes its customary forecast of the probable supply and demand for wheat in the year 1935-36. The estimates available at the date of the forecast were partly conjectural, but so far as could be foreseen, the world crop of 1935 (excluding Russia) appeared likely to be small, though slightly better than that of 1934. None of the four chief exporting countries reported a satisfactory harvest, and for the third successive year the crop in the United States is estimated as smaller than the internal requirements. The total exportable surplus from the new-world crop of 1935 is put at 430 million bushels, while the import requirements of European and other countries are likely to amount to about 540 million

bushels. It will be necessary to draw the difference from old crop stocks, thus reducing the probable carry over at the end of the present season (*i.e.* July, 1936) to about 260 million bushels, the lowest figure since 1928. If these forecasts prove correct, the surplus stocks which have for so long been depressing the price of wheat on the world market will be brought to a level which prior to 1929 was regarded as normal.

CURRENT NOTES.

Two years ago the Manchester Statistical Society formed a "Group for the Study of Statistical Methods," and in the course of last year they published a pamphlet of 54 pages containing summary reports of twelve meetings held between January, 1934, and May, 1935. The papers dealt with "The Statistical Measurement of Business Activity" (Colin G. Clark), "Methods of Analysing Time-Series" (L. H. C. Tippett), "Seasonal Variations in Employment in the United Kingdom" (C. T. Saunders), "The Measurement of Price Changes" (H. Campion), "An Attempt at Forecasting the Population of Manchester and Lancashire" (N. W. Ross), "The Co-ordination of the Records of Births, Marriages, and Deaths" (D. Caradog Jones), "Banking Statistics and their Interpretation" (D. H. Peacock), "Transport Statistics" (Dr. K. G. Fenelon), "The International Comparison of Industrial Production" (R. Robson), "Some Theoretical Considerations of the Meaning of 'Trend'" (Dr. Adolf Lowe), "The Optimum Size of a Local Authority" (D. N. Chester), and "Some Aspects of Retail Distribution" (George Darling). Six of the lecturers are Fellows of the Royal Statistical Society. Although summaries can never be satisfying they can be very suggestive. Mr. Tippett says of analyses of time-series: "All methods are based on the assumption that fundamental economic movements follow some comparatively simple mathematical form. Where several forms give different results, how shall we say which is nearest the truth?" Should not one say, perhaps, is the assumption justified? Again, one would like to see Mr. Colin Clark's unpublished index numbers of the cost of living and of building costs. One also badly wants to see the detail figures of Mr. Saunders' very interesting analysis. Mr. Campion's notes on price changes are acute and valuable—and so one might go on through the other papers with appreciation. We congratulate the Manchester Statistical Society.

Dr. Jerzy Neyman, a Fellow whose work in mathematical statistics will be known to readers of the *Journal* and *Supplement*, was invited to deliver a course of lectures at the Institut Henri Poincaré of the University of Paris in January. He chose, as the subject of his six lectures, "Les problèmes d'estimation statistique et de vérification des hypothèses."

The School of Slavonic and East European Studies in the University of London is rendering very useful service in the publication of monographs on subjects of economic importance, among which have been studies of Money, Prices and Gold, and of Banking and Credit, in the Soviet Union. Nos. 7 and 8, issued as a single pamphlet, examine respectively the prospects of British and of American trade with the U.S.S.R. The authors of the separate studies both arrive at the conclusion that the Russian market can only be considered of secondary importance, since it is limited to the amount of the credits the Soviet Union can obtain, and this depends upon the exporting capacity of the Union. At the same time, the paper on British trade repeats the opinion given in a previous monograph (No. 1) that the Commercial Agreement with the U.S.S.R. affords a basis for the satisfactory development of trade relations, and points out that, though the absolute figures are small, in 1934 more goods went to Russia from this country than from any other.

We are asked to make it known that the Sixth European Meeting of the Econometric Society will be held at New College, Oxford, during the week-end September 25th-28th, 1936, beginning on Friday 25th at 10 a.m.

Members desiring to attend should write to Mr. E. H. Phelps Brown, New College, enclosing a remittance of 2s. 6d. They will receive further details regarding the programme, accommodation in College, etc.

Drafts or summaries of papers should be sent before July 1st to Mr. J. Marschak, All Souls College, Oxford.

In addition to the regular programme of papers, an attempt is to be made to discuss surveys on recent developments within economics, including economic theory.

Application is now invited for the Leverhulme Research Fellowships and Grants to be awarded in 1936. Any subject which may add to human knowledge may be proposed for a Fellowship, but preference is given to subjects in which other provision for research is inadequate. The first of these Fellowships was awarded by the Trustees in 1933, and 68 awards have been made in all. Of these, fourteen have been given for research in social problems, economics and politics.

Forms of application and full particulars may be obtained from the Secretary, Dr. L. Haden-Guest, Leverhulme Research Fellowships, Union House, St. Martins-le-Grand, London, E.C. 1.

Applications must be received on or before March 1st, 1936. Awards will be announced in July, and the Fellowships or Grants will date from Sept. 1st, 1936.

Fellows will be aware from comments in the Press that the part of the Adelphi Estate which includes the Terrace has been sold for demolition and reconstruction, and that in consequence the Society must leave the house which has been their home for over fifty years. Their address after March 25th next will be No. 4, Portugal Street (Kingsway), W.C. 2. As there are nearly 80,000 books to be moved, it was necessary to begin to pack and transport them early in February, in order that all may be in place when the Society enters on occupation of the new premises. The Library has therefore had to be closed for the present.

STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS.

UNITED KINGDOM—

Barclays Bank, Monthly Review, January, 1936—Trade conditions. British agriculture.

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Agriculture and Fisheries, Ministry of—

Economic series No. 25. Vegetable marketing in England and Wales. London: H.M.S.O., 1935. 9 $\frac{3}{4}$ " \times 6". vi + 256 pp. 1s.

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Censo de la población de España . . . Región de Aragón. Madrid, 1935. 10¼" × 8¼". 61 + 57 + 57 + 53 pp.

La demografía Española en el decenio 1921-30. Primera parte—Población y natalidad. Sección primera. Madrid, 1935. 10½" × 7½". clxxxviii pp.

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REVENUE OF THE UNITED KINGDOM.

*Net Produce in Quarters of 1935, and in Financial Years ended
March 31, 1934-35, 1933-34, 1932-33, 1931-32.*

(000's omitted.)

QUARTERS, ended	March 31, 1935.	June 30, 1935.	Sept. 30, 1935.	Dec. 31, 1935.	Total for calendar year 1935.
Customs	£ 44,687	£ 47,626	£ 50,013	£ 50,689	£ 193,015
Excise	23,400	26,100	25,800	31,000	106,300
Stamps and Estate Duties	31,041	26,770	29,560	24,330	111,701
Land Tax and Mineral Rights Duty	590	110	20	30	750
Postal Service	18,800	18,000	18,450	22,750	78,000
Telegraph Service					
Telephone Service					
Property and Income Tax, in- cluding Super Tax	118,518	118,606	123,843	128,799	489,766
Excess Profits Duties	311,416	137,566	163,980	158,838	771,800
Corporation Profits Tax	2,300	—	—	—	2,300
Motor Vehicles Duties	19,081	4,319	3,677	2,551	29,628
Crown Lands	290	260	380	410	1,340
Interest on Sundry Loans	1,062	263	2,743	633	4,703
Miscellaneous and Special Re- ceipts	2,710	4,385	6,717	5,743	19,555
	836,859	146,793	177,499	168,175	829,326

YEARS, ended March 31,	1934-35.	1933-34.	1934-35 (compared with 1933-34).		Corresponding years.	
			Increase.	Decrease.	1932-33.	1931-32.
Customs	£ 185,096	£ 179,177	£ 5,919	£ —	£ 167,235	£ 136,152
Excise	104,600	107,000	—	2,400	120,900	119,900
Stamps and Estate Duties	105,466	107,980	—	2,514	96,360	82,070
Land Tax and Mineral Rights Duty	770	800	—	30	770	850
Postal Service	71,000	72,400	1,600	—	70,200	69,500
Telegraph Service						
Telephone Service						
Property and Income Tax, in- cluding Super Tax	460,932	467,357	7,519	4,044	455,465	408,472
Excess Profits Duties	250,042	281,522	—	1,480	312,189	364,067
Corporation Profits Tax	749,974	748,879	7,519	1,095	767,654	772,539
Motor Vehicle Duties	2,300	1,800	500	—	2,200	2,500
Crown Lands	31,538	30,712	826	—	27,910	27,480
Interest on Sundry Loans	1,320	1,230	90	—	1,220	1,250
Miscellaneous— Ordinary receipts	4,372	4,655	—	283	5,125	13,810
Special receipts	15,125	22,103	—	6,978	22,922	29,913
Appropriation from Rating Relief Suspense Account ..						
Total	804,629	809,379	8,935	13,685	827,031	851,482
			NET DEC. £4,750			

Values (c.i.f.) of Imports* into the United Kingdom for the years 1933-34-35.

(From the Monthly Trade Returns, December, 1935.)

	Year ended December 31,			Increase or Decrease, 1935-1934.	Increase or Decrease, 1935-1933.
	1933.	1934.	1935.		
I. FOOD, DRINK AND TOBACCO—	£	£	£	£	£
A. Grain and flour	53,018,113	54,390,606	56,751,752	+ 2,361,146	+ 1,733,639
B. Feeding-stuffs for animals	5,950,788	7,429,216	7,709,430	+ 280,214	+ 1,758,642
C. Animals, living, for food	7,051,944	5,265,106	5,567,905	+ 302,799	- 1,484,039
D. Meat	77,535,855	81,518,831	77,796,103	- 3,732,728	+ 260,218
E. Dairy produce	53,127,437	52,878,129	58,442,635	+ 5,564,496	+ 3,315,188
F. Fresh fruit and vegetables	36,959,104	35,174,031	39,682,310	+ 4,508,279	+ 2,723,206
G. Beverages and cocoa pre- parations	41,193,833	44,400,619	42,926,848	- 1,473,771	+ 1,728,015
H. Other food	49,203,008	48,578,480	49,496,085	+ 917,605	+ 291,077
I. Tobacco	11,786,487	16,953,463	17,583,126	+ 629,663	+ 5,796,639
Total, Class I	339,833,569	346,588,481	355,956,184	+ 9,367,703	+ 16,122,615
II. RAW MATERIALS AND ARTICLES MAINLY UNMANUFACTURED—					
A. Coal	17,879	23,401	20,222	- 3,182	+ 2,343
B. Other non-metalliferous min- ing and quarry products and the like	3,150,308	3,875,610	4,206,898	+ 421,258	+ 800,500
C. Iron ore and scrap	2,592,814	4,532,243	3,040,810	+ 508,567	+ 2,447,996
D. Non-ferrous metalliferous ores and scrap	6,886,297	10,091,344	11,622,355	+ 1,531,011	+ 4,736,038
E. Wood and timber	29,863,883	39,197,136	35,564,114	- 3,633,022	+ 5,701,229
F. Raw cotton and cotton waste	36,840,062	36,051,176	37,188,819	+ 1,137,643	+ 348,757
G. Wool, raw and waste, and woollen rags	37,406,024	38,205,069	30,761,596	- 1,443,473	- 644,428
H. Silk, raw, knots and noils	1,338,351	1,341,412	1,515,209	+ 173,797	+ 176,838
I. Other textile materials	7,240,647	8,496,653	9,855,787	+ 1,359,134	+ 2,615,140
J. Seeds and nuts for oil, oils, fats, resins and gums	21,067,279	21,384,723	23,902,824	+ 4,518,101	+ 4,835,545
K. Hides and skins, undressed ...	14,272,456	14,739,654	14,654,283	- 85,371	+ 381,827
L. Paper-making materials	9,342,436	11,109,620	10,762,099	- 347,521	+ 1,419,663
M. Rubber	3,008,876	12,026,079	10,149,300	- 1,876,779	+ 7,140,424
N. Miscellaneous raw materials and articles mainly un- manufactured	7,083,782	8,132,033	8,424,077	+ 292,044	+ 1,338,345
Total, Class II	180,398,136	209,506,186	211,758,303	+ 2,252,207	+ 31,360,237
III. ARTICLES WHOLLY OR MAINLY MANUFACTURED—					
A. Coke and manufactured fuel ...	30,506	37,514	43,323	+ 7,809	+ 11,617
B. Pottery, glass, abrasives, &c. ...	5,790,628	7,025,222	7,263,907	+ 238,385	+ 1,483,279
C. Iron and steel and manu- factures thereof	6,125,408	9,171,200	8,717,304	- 453,986	+ 2,591,896
D. Non-ferrous metals and manufactures thereof	15,696,371	22,031,589	27,965,115	+ 5,933,526	+ 12,268,744
E. Cutlery, hardware, imple- ments and instruments ...	5,139,812	5,755,153	6,200,198	+ 445,045	+ 1,060,386
F. Electrical goods and apparatus	2,439,309	3,065,025	3,088,539	+ 23,514	+ 649,230
G. Machinery	8,626,155	11,231,672	13,144,004	+ 1,912,332	+ 4,517,869
H. Manufactures of wood and timber	5,142,984	5,539,300	6,169,822	+ 610,522	+ 1,026,838
I. Cotton yarns and manu- factures	2,119,831	2,275,789	2,380,993	+ 105,454	+ 261,162
J. Woollen and worsted yarns and manufactures	2,324,850	2,483,314	2,467,920	- 15,394	+ 143,090
K. Silk yarns and manufactures	3,125,112	3,072,086	3,028,962	- 43,134	- 96,150
L. Manufactures of other textile materials	7,441,803	7,050,231	6,769,643	- 280,588	- 672,160
M. Apparel	7,451,529	7,891,047	7,762,480	- 131,567	+ 310,951
N. Chemicals, drugs, dyes and colours	9,923,496	11,289,980	11,941,031	+ 651,051	+ 2,017,535
O. Oils, fats and resins, manu- factured	29,668,736	30,892,054	32,668,757	+ 1,776,703	+ 2,700,021

* The value of the Imports represents the cost, insurance and freight; or, when goods are consigned for sale, the latest sale value of such goods.

Values (c.i.f.) of Imports for the years 1933-34-35—Contd.

(From the Monthly Trade Returns, December, 1935.)

	Year ended December 31,			Increase or Decrease, 1935—1934.	Increase or Decrease, 1935—1933.
	1933.	1934.	1935.		
III. ARTICLES WHOLLY OR MAINLY MANUFACTURED—Contd.	£	£	£	£	£
P. Leather and manufactures thereof	8,178,619	7,467,921	8,123,935	+ 656,014	— 54,684
Q. Paper, cardboard, &c.	12,017,451	13,125,508	13,507,413	+ 381,905	+ 1,459,962
R. Vehicles (including locomotives, ships and aircraft....)	2,465,971	3,469,067	4,524,422	+ 1,055,355	+ 2,058,451
S. Rubber manufactures.....	1,627,110	1,332,538	1,299,454	— 33,084	— 327,656
T. Miscellaneous articles wholly or mainly manufactured }	15,310,954	17,136,676	18,062,269	+ 925,593	+ 2,751,315
Total, Class III	150,963,595	171,366,036	185,181,491	+13,765,455	+34,167,896
IV. ANIMALS, NOT FOR FOOD	757,719	1,457,270	1,645,631	+ 188,361	+ 887,912
V. PARCEL POST	3,063,100	2,495,810	2,444,476	— 51,334	— 618,624
Total	673,016,119	731,413,783	756,936,175	+25,522,392	+81,920,036

Values (f.o.b.) of Exports* of Produce and Manufactures of the United Kingdom for the years 1933-34-35.

(From the Monthly Trade Returns, December, 1935.)

	Year ended December 31,			Increase or Decrease, 1935—1934.	Increase or Decrease, 1935—1933.
	1933.	1934.	1935.		
I. FOOD, DRINK AND TOBACCO—	£	£	£	£	£
A. Grain and flour	1,969,982	1,784,131	1,827,388	+ 43,257	— 142,594
B. Feeding-stuffs for animals.....	803,716	598,582	572,049	— 26,533	— 233,667
C. Animals, living, for food	32,238	22,652	6,659	— 15,993	— 25,579
D. Meat	811,070	818,938	920,650	+ 101,712	+ 109,580
E. Dairy produce.....	919,504	880,694	1,073,338	+ 192,642	+ 153,832
F. Fresh fruit and vegetables.....	267,094	314,825	302,463	— 12,362	+ 35,369
G. Beverages and cocoa preparations	6,570,296	9,449,534	9,767,126	+ 317,592	+ 3,196,830
II. Other food	12,293,726	12,218,631	12,953,100	+ 734,469	+ 659,374
I. Tobacco	4,094,530	4,366,063	4,214,761	— 151,302	+ 120,231
Total, Class I	27,764,156	30,451,050	31,627,532	+ 1,183,482	+ 3,873,376
II. RAW MATERIALS AND ARTICLES MAINLY UNMANUFACTURED—					
A. Coal	31,426,236	31,854,490	31,558,566	— 295,924	+ 132,330
B. Other non-metalliferous mining and quarry products and the like.....	1,019,096	1,028,399	1,092,557	+ 63,958	+ 73,261
C. Iron ore and scrap	484,920	536,094	457,826	— 78,268	— 27,094
D. Non-ferrous metalliferous ores and scrap.....	1,005,933	1,158,597	1,763,044	+ 609,417	+ 757,091
E. Wood and timber	91,398	106,324	83,966	— 22,358	— 7,432
F. Raw cotton and cotton waste	463,734	864,225	1,115,663	+ 251,438	+ 651,929
G. Wool, raw and waste, and woollen rags.....	5,315,970	5,977,857	8,172,661	+ 2,194,804	+ 2,856,691
H. Silk, raw, kumbs and noils.....	9,815	57,462	13,394	— 44,068	+ 3,579
I. Other textile materials	386,675	384,296	400,940	+ 16,644	+ 14,265
J. Seeds and nuts for oil, oils, fats, resins and gums.....	1,681,720	1,681,089	3,179,276	+ 1,498,187	+ 1,497,536
K. Hides and skins, undressed	676,456	742,649	1,104,260	+ 361,611	+ 427,804
L. Paper-making materials.....	907,323	1,121,597	1,087,307	— 27,290	+ 189,974
M. Rubber	95,290	113,906	164,103	+ 50,197	+ 68,813
N. Miscellaneous raw materials and articles mainly un- manufactured	2,422,491	2,632,723	2,595,441	— 37,282	+ 172,950
Total, Class II.....	43,987,087	48,257,708	52,798,804	+ 4,541,096	+ 6,811,717

* The value of the Exports represents the cost and the charges of delivering the goods on board the ship, and is known as the "free on board" value.

Values (f.o.b.) of Exports for the years 1933-34-35—Contd.

(From the Monthly Trade Returns, December, 1935.)

	Year ended December 31,			Increase or Decrease, 1935—1934.	Increase or Decrease, 1935—1933.
	1933.	1934.	1935.		
III. ARTICLES WHOLLY OR MAINLY MANUFACTURED—	£	£	£	£	£
A. Coke and manufactured fuel...	2,658,672	2,748,103	3,019,913	+ 271,810	+ 361,241
B. Pottery, glass, abrasives, &c.	7,040,782	7,734,103	8,307,312	+ 573,209	+ 1,266,530
C. Iron and steel and manu- factures thereof	29,879,132	35,092,053	37,093,242	+ 2,001,189	+ 7,214,110
D. Non-ferrous metals and manufactures thereof	12,142,997	11,889,802	14,085,471	+ 2,195,669	+ 1,942,474
E. Cutlery, hardware, imple- ments and instruments	6,389,394	7,406,883	8,126,960	+ 720,077	+ 1,737,566
F. Electrical goods and apparatus	6,696,617	8,033,231	9,545,324	+ 1,512,093	+ 2,848,707
G. Machinery	27,143,266	32,806,350	33,495,459	+ 5,689,109	+ 11,352,173
H. Manufactures of wood and timber	998,681	1,018,149	1,061,720	+ 13,571	+ 63,039
I. Cotton yarns and manu- factures	58,933,027	59,095,689	60,177,623	+ 1,081,936	+ 1,244,598
J. Woollen and worsted yarns and manufactures	25,381,986	28,848,532	30,379,149	+ 1,530,597	+ 4,997,163
K. Silk yarns and manufactures	853,922	1,058,073	1,142,361	+ 84,308	+ 286,459
L. Manufactures of other textile materials	14,027,158	15,607,243	15,737,134	+ 130,186	+ 1,710,276
M. Apparel	10,736,353	10,909,701	10,930,554	— 79,147	+ 94,169
N. Chemicals, drugs, dyes and colours	18,567,696	19,556,545	20,420,193	+ 863,588	+ 1,852,437
O. Oils, fats and resins, manu- factured	4,699,959	4,915,565	5,163,516	+ 247,951	+ 463,557
P. Leather and manufactures thereof	3,713,959	3,355,034	4,016,028	+ 660,994	+ 302,069
Q. Paper, cardboard, &c.	6,129,136	6,276,112	6,623,606	+ 347,494	+ 494,470
R. Vehicles (including locomo- tives, ships and aircraft)	22,053,064	24,142,155	28,532,128	+ 4,389,973	+ 6,379,064
S. Rubber manufactures	1,699,365	1,751,848	1,749,265	— 2,583	+ 49,900
T. Miscellaneous articles wholly or mainly manufactured	21,749,440	22,565,639	24,629,964	+ 2,064,325	+ 2,880,515
Total, Class III	261,696,667	304,540,335	328,937,184	+ 24,086,349	+ 47,240,517
IV. ANIMALS, NOT FOR FOOD	489,285	628,615	673,439	+ 14,824	+ 184,154
V. PARCEL POST	11,971,857	11,804,313	11,874,384	+ 70,071	— 97,473
Total	367,909,052	395,985,221	425,921,343	+ 29,935,622	+ 58,012,291

Values (f.o.b.) of Exports of Imported Merchandise for the years 1933-34-35.*

(From the Monthly Trade Returns, December, 1935.)

	Year ended December 31,			Increase or Decrease, 1935—1934.	Increase or Decrease, 1935—1933.
	1933.	1934.	1935.		
I. FOOD, DRINK AND TOBACCO—	£	£	£	£	£
A. Grain and flour	760,205	963,351	755,627	— 177,724	+ 25,422
B. Feeding-stuffs for animals	58,130	82,754	59,716	— 23,038	+ 1,586
(*) Animals, living, for food	4	—	—	—	4
D. Meat	790,795	717,282	814,259	+ 66,977	+ 23,464
E. Dairy produce	586,212	555,912	777,284	+ 221,372	+ 191,072
F. Fresh fruit and vegetables	1,370,791	1,226,478	1,271,060	+ 32,582	+ 99,731
G. Beverages and cocoa pre- parations	6,674,282	6,777,279	6,149,053	— 328,226	— 225,229
H. Other food	1,167,736	1,058,673	1,543,412	+ 489,739	+ 380,676
I. Tobacco	691,483	1,213,893	859,819	— 354,074	+ 168,336
Total, Class I	12,999,638	12,637,622	12,565,230	— 72,392	+ 465,592

* The value of the Exports represents the cost and the charges of delivering the goods on board the ship, and is known as the "free on board" value.

Values (f.o.b.) of Exports of Imported Merchandise for the years
1933-34-35—Contd.

(From the Monthly Trade Returns, December, 1935.)

	Year ended December 31,			Increase or Decrease, 1935-1934.	Increase or Decrease, 1935-1933.
	1933.	1934.	1935.		
	£	£	£	£	£
II. RAW MATERIALS AND ARTICLES					
MAINLY UNMANUFACTURED—					
A. Coal	—	—	—	—	—
B. Other non-metalliferous min- ing and quarry products and the like.....	199,442	276,397	218,458	— 57,939	+ 19,016
C. Iron ore and scrap	226	1,253	1,514	+ 261	+ 1,288
D. Non-ferrous metalliferous ores and scrap.....	113,327	250,474	410,888	+ 160,414	+ 297,561
E. Wood and timber	191,720	222,154	281,585	+ 59,431	+ 89,865
F. Raw cotton and cotton waste	1,736,081	2,056,196	2,860,549	+ 304,353	+ 624,468
G. Wool, raw and waste, and woollen rags.....	13,558,918	12,646,541	11,552,968	— 1,098,573	— 2,005,950
H. Silk, raw, knubs and noils.....	12,391	50,879	9,557	— 41,322	— 2,734
I. Other textile materials	249,092	433,468	591,693	+ 158,225	+ 342,601
J. Seeds and nuts for oil, oils, fats, resins and gums.....	380,979	523,743	1,247,729	+ 723,986	+ 866,730
K. Hides and skins, undressed ...	7,228,071	6,971,998	8,287,870	+ 1,315,872	+ 1,059,799
L. Paper-making materials.....	74,340	37,184	40,893	— 3,179	— 33,977
M. Rubber	904,828	3,180,952	2,828,167	— 263,785	+ 1,921,339
N. Miscellaneous raw materials and articles mainly un- manufactured	982,115	1,013,164	1,084,214	+ 71,050	+ 102,099
Total, Class II	25,631,430	27,673,403	28,913,555	+ 1,240,152	+ 3,282,125
III. ARTICLES WHOLLY OR MAINLY					
MANUFACTURED—					
A. Coke and manufactured fuel...	358	177	147	— 30	— 211
B. Pottery, glass, abrasives, &c.	58,942	60,430	62,631	+ 2,201	+ 5,689
C. Iron and steel and manu- factures thereof	50,600	61,496	81,007	+ 19,511	+ 30,407
D. Non-ferrous metals and manufactures thereof.....	730,163	1,293,092	4,038,443	+ 2,745,351	+ 3,308,280
E. Cutlery, hardware, imple- ments and instruments ...	702,557	715,780	723,066	+ 7,286	+ 20,509
F. Electrical goods and apparatus	125,672	94,686	82,134	— 12,552	— 43,538
G. Machinery	779,364	826,082	849,108	+ 23,026	+ 69,744
H. Manufactures of wood and timber	140,822	143,171	162,625	+ 19,454	+ 21,803
I. Cotton yarns and manu- factures	152,890	127,508	143,950	+ 16,352	— 8,940
J. Woollen and worsted yarns and manufactures	696,039	593,324	522,316	— 71,008	— 173,723
K. Silk yarns and manufactures	301,849	277,643	289,315	+ 11,672	— 12,534
L. Manufactures of other textile materials	378,594	581,238	513,268	+ 37,970	+ 335,326
M. Apparel	462,885	557,529	528,393	— 29,136	+ 65,508
N. Chemicals, drugs, dyes and colours	1,172,400	820,228	578,879	— 241,349	— 593,521
O. Oils, fats and resins, manu- factured	1,450,610	1,533,870	1,699,589	+ 165,719	+ 248,979
P. Leather and manufactures thereof	1,116,019	919,432	1,043,773	+ 124,341	— 72,246
Q. Paper, cardboard, &c.	60,085	45,209	63,324	+ 18,115	+ 3,239
R. Vehicles (including locomotives, ships and aircraft)	291,297	142,833	140,051	— 2,781	— 151,246
S. Rubber manufactures	126,567	64,824	41,075	— 23,749	— 85,492
T. Miscellaneous articles wholly or mainly manufactured }	1,821,997	1,766,881	1,910,405	+ 143,524	+ 88,408
Total, Class III	11,117,710	10,625,522	13,503,499	+ 2,877,977	+ 2,385,789
IV. ANIMALS NOT FOR FOOD	231,949	306,800	283,092	— 23,708	+ 51,143
Total	49,080,727	51,243,347	55,265,376	+ 4,022,029	+ 6,184,649

BANK OF ENGLAND.

Pursuant to the Act 7th and 8th Victoria, cap. 32 (1844),

(000's omitted.)

1	2	3	4	5	6	7	8
ISSUE DEPARTMENT.						COLLATERAL COLUMNS.	
Liabilities.	DATES.	Assets.				Notes in Hands of Public.	Minimum Discount Rate.
Notes Issued.	(Wednesdays.)	Govt. Debt (£11,015) and Govt. Securities.	Other Securities.	Gold Coin and Bullion.	Silver Coin.		
£		£	£	£	£	£	Per cent.
452,302	Jan. 2.....	256,591	960	192,302	2,449	394,731	2
452,302	" 9.....	257,086	466	192,302	2,448	385,607	
452,404	" 16.....	256,906	647	192,404	2,447	378,107	
452,404	" 23.....	257,003	550	192,404	2,447	373,824	
452,434	" 30.....	256,879	675	192,434	2,446	374,941	
452,434	Feb. 6.....	256,731	820	192,434	2,449	376,988	
452,434	" 13.....	256,654	901	192,434	2,446	374,946	
452,499	" 20.....	256,660	896	192,499	2,444	373,260	
452,499	" 27.....	256,632	921	192,499	2,447	377,438	
452,521	Mar. 6.....	256,847	706	192,521	2,417	380,066	
452,521	" 13.....	257,140	410	192,521	2,450	378,920	
452,523	" 20.....	257,806	346	192,523	2,348	377,959	
452,523	" 27.....	257,737	159	192,523	2,104	381,441	
452,556	April 3.....	257,793	205	192,556	2,000	386,991	
452,556	" 10.....	257,875	175	192,556	1,950	388,308	
452,556	" 17.....	257,872	229	192,556	1,900	392,449	
452,578	" 24.....	257,887	209	192,578	1,904	393,182	
452,578	May 1.....	258,025	182	192,578	1,798	392,578	
452,639	" 8.....	258,054	154	192,639	1,792	394,250	
452,639	" 15.....	257,896	815	192,639	1,789	390,321	
452,639	" 22.....	257,937	277	192,639	1,786	387,610	
452,639	" 29.....	258,043	162	192,639	1,795	390,406	
452,664	June 5.....	257,936	273	192,664	1,791	395,891	
452,664	" 12.....	257,997	208	192,664	1,795	398,761	
452,716	" 19.....	257,889	319	192,716	1,792	395,730	
452,716	" 26.....	257,045	261	192,716	1,794	396,860	
452,717	July 3.....	257,948	256	192,717	1,796	401,371	
452,717	" 10.....	258,076	236	192,717	1,688	400,652	
452,717	" 17.....	257,634	675	192,717	1,687	399,568	
452,717	" 24.....	257,394	966	192,717	1,640	400,870	
452,774	" 31.....	257,116	1,016	192,774	1,538	408,262	
452,774	Aug. 7.....	257,909	515	192,774	1,546	411,836	
452,774	" 14.....	257,934	527	192,774	1,539	405,546	
452,852	" 21.....	257,732	730	193,251	1,538	400,440	
452,855	" 28.....	257,620	812	193,355	1,538	399,565	
452,855	Sept. 4.....	257,620	812	193,355	1,538	401,622	
452,402	" 11.....	257,603	857	193,402	1,540	400,256	
452,478	" 18.....	257,431	1,030	193,478	1,539	398,149	
452,573	" 25.....	257,311	1,118	193,573	1,541	398,164	
452,613	Oct. 2.....	257,331	1,130	193,643	1,539	402,033	
452,673	" 9.....	257,379	1,081	193,673	1,540	402,116	
452,673	" 16.....	257,382	1,080	193,673	1,538	399,618	
452,324	" 23.....	257,340	1,120	194,324	1,540	397,014	
452,684	" 30.....	257,172	1,285	194,684	1,542	399,889	
452,483	Nov. 6.....	256,962	1,499	195,483	1,539	402,158	
452,458	" 13.....	256,970	1,493	196,458	1,537	401,449	
457,189	" 20.....	257,300	1,161	197,189	1,539	398,900	
457,632	" 27.....	257,316	1,142	197,632	1,542	401,345	
452,400	Dec. 4.....	257,348	1,113	198,409	1,539	405,568	
452,409	" 11.....	257,372	1,089	199,409	1,540	410,931	
460,051	" 18.....	257,344	1,104	200,051	1,532	419,464	
460,051	" 25.....	257,356	1,392	200,051	1,532	424,507	
460,051	Jan. 1.....	257,368	1,377	200,051	1,555	411,750	

WEEKLY RETURN.

for Wednesday in each Week, during the Year 1935.

(000's omitted.)

9	10	11	12	13	14	15	16	17	18
BANKING DEPARTMENT.									
Liabilities.				DATES. (Wednes- days.)	Assets.				Totals of Liabilities and Assets.
Capital (£14,553) and Res.	Public Deposits.	Bankers' Deposits.	Other Deposits.		Govt. Securi- ties.	Dis- counts and Ad- vances.	Other Securi- ties.	Reserve (Notes and Coin).	
£	£	£	£		£	£	£	£	£
18,048	9,931	117,343	36,822	Jan. 2	89,336	24,196	10,562	58,050	182,144
18,084	11,905	108,522	36,572	" 9	88,096	9,041	10,755	67,191	175,083
18,095	14,163	108,788	36,116	" 16	83,356	9,033	9,866	74,837	177,112
18,135	16,969	108,238	36,350	" 23	81,121	9,122	10,267	79,172	179,682
18,151	20,949	98,956	42,102	" 30	82,521	9,291	10,227	78,118	180,158
18,178	16,534	104,069	39,348	Feb. 6	82,911	9,277	9,907	76,034	178,129
18,178	18,340	101,820	40,127	" 13	82,766	7,943	9,979	78,076	178,765
18,210	26,304	94,826	40,901	" 20	81,599	6,998	11,839	79,805	180,241
18,242	19,353	95,519	40,714	" 27	82,421	6,246	9,538	75,623	173,828
18,355	11,202	104,484	40,414	Mar. 6	85,146	5,426	10,757	73,026	174,355
18,353	8,447	108,373	40,400	" 13	84,771	5,706	10,910	74,085	175,473
18,262	14,854	105,239	40,573	" 20	85,951	5,433	12,465	75,099	178,948
18,204	20,107	96,625	41,227	" 27	87,636	5,552	11,382	71,683	176,253
18,309	10,549	109,674	40,459	April 3	96,096	5,781	10,956	66,158	178,991
17,666	9,216	103,297	39,656	" 10	88,476	6,346	10,231	64,782	169,835
17,072	9,747	100,294	39,393	" 17	89,986	5,923	10,002	60,596	166,506
17,698	7,624	98,136	39,598	" 24	87,731	5,820	9,621	59,885	163,056
17,724	8,007	115,528	40,025	May 1	104,871	6,008	9,873	60,532	181,279
17,747	7,248	104,559	38,012	" 8	92,476	5,799	10,295	58,997	167,566
17,763	7,367	103,008	38,491	" 15	86,908	5,708	11,025	62,990	166,629
17,778	14,357	100,782	35,570	" 22	83,486	5,368	11,838	63,795	168,487
17,814	23,077	88,041	35,989	" 29	83,421	5,254	11,241	63,005	164,921
17,833	7,612	102,592	36,109	June 5	89,976	5,380	11,226	57,564	164,146
17,887	7,789	101,740	35,942	" 12	89,346	5,871	10,463	54,657	163,338
17,919	13,595	104,025	37,005	" 19	94,941	5,795	14,127	57,681	172,544
17,960	16,164	102,361	38,735	" 26	96,186	10,165	12,426	56,483	175,240
18,006	9,630	110,513	37,978	July 3	98,196	13,488	12,550	51,893	176,127
18,035	8,361	108,593	36,866	" 10	94,801	10,373	13,582	52,620	171,375
18,074	7,883	103,582	38,515	" 17	91,886	9,377	13,549	53,672	168,384
18,111	8,871	100,815	36,607	" 24	88,741	10,322	12,891	52,450	164,404
18,132	24,360	75,680	38,500	" 31	87,371	10,842	13,359	45,100	156,672
18,155	17,240	82,662	37,816	Aug. 7	87,201	14,078	13,115	41,508	155,993
18,180	16,718	86,275	37,021	" 14	82,043	15,171	13,154	47,824	158,194
18,213	15,902	83,898	36,900	" 21	83,490	12,932	15,002	52,469	164,913
18,240	9,360	96,935	36,454	" 28	81,275	12,935	12,260	54,519	160,989
18,260	5,860	100,063	38,646	Sept. 4	83,415	14,080	12,841	52,493	162,329
18,257	16,036	91,036	37,843	" 11	84,550	12,418	12,232	53,171	163,172
18,274	17,465	92,018	37,581	" 18	83,160	11,853	14,160	56,166	165,338
18,274	19,492	87,241	38,956	" 25	83,165	12,411	12,191	56,196	163,963
18,307	25,453	80,875	39,135	Oct. 2	82,520	17,252	11,597	52,401	163,770
17,045	35,991	75,078	38,596	" 9	83,495	17,819	11,848	52,348	167,310
17,668	32,120	78,801	37,761	" 16	86,153	13,660	11,640	54,886	166,350
17,681	35,325	78,706	37,084	" 23	86,775	11,386	12,479	58,166	168,806
17,701	26,226	82,521	38,552	" 30	85,890	11,210	12,270	55,633	165,004
17,735	21,009	89,559	36,641	Nov. 6	87,215	10,986	12,493	54,250	164,944
17,764	15,809	92,807	36,700	" 13	88,475	11,103	12,631	55,927	163,139
17,791	21,630	90,941	36,501	" 20	83,620	9,713	14,560	59,169	166,861
17,829	19,707	90,887	36,536	" 27	85,545	9,500	12,320	57,094	164,959
17,882	7,074	103,711	37,537	Dec. 4	89,417	10,714	12,501	53,572	166,205
17,903	6,843	94,937	37,204	" 11	84,213	10,080	12,912	49,132	165,336
17,911	10,254	79,802	37,841	" 18	82,750	7,173	14,181	41,304	145,308
17,982	12,146	72,079	37,109	" 25	81,855	8,501	12,804	36,155	139,316
18,034	9,966	130,543	37,290	Jan. 1	110,365	23,655	12,953	48,859	195,832

FOREIGN EXCHANGES.—*Quotations as under, LONDON on Paris, Berlin and Calcutta; New York and Hong Kong on LONDON, 1935.*

DATE. Wednesdays.)	1	2	3	4	5	6		7
	London on Paris.	London on Berlin.	London on Calcutta.	New York on London.	Hong Kong on London.	Price per Ounce.		
	Cables (middle rate).	Cables (middle rate).	Demand (middle rate).	Cables (closing rate).	T.T.	Gold Bars (fine).	Silver Standard Bars (cash).	
1935.	<i>f. c.</i>	<i>Reich- marks.</i>	<i>s. d.</i>	<i>\$ c.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	
Jan. 2.....	74 $\frac{1}{2}$	12.26	1.6 $\frac{1}{2}$	4.94	1.8 $\frac{7}{8}$	140.10 $\frac{1}{2}$	2.0 $\frac{5}{8}$	
„ 16.....	74 $\frac{1}{2}$	12.21	1.6 $\frac{1}{8}$	4.87 $\frac{3}{4}$	1.9 $\frac{5}{8}$	141.6	2.0 $\frac{1}{8}$	
„ 30.....	74 $\frac{1}{2}$	12.21	1.6 $\frac{1}{16}$	4.87 $\frac{1}{2}$	1.9 $\frac{5}{8}$	142.1	2.0 $\frac{1}{16}$	
Feb. 13.....	74 $\frac{1}{2}$	12.18	1.6 $\frac{1}{16}$	4.88	1.9 $\frac{3}{4}$	142.4	2.0 $\frac{1}{16}$	
„ 27.....	73 $\frac{3}{4}$	12.04	1.6 $\frac{1}{16}$	4.86 $\frac{1}{8}$	1.11	143.11 $\frac{1}{2}$	2.1 $\frac{1}{8}$	
Mar. 13.....	71 $\frac{3}{4}$	11.74	1.6 $\frac{3}{4}$	4.74 $\frac{1}{2}$	2.0 $\frac{1}{2}$	148.0	2.3 $\frac{5}{8}$	
„ 27.....	72 $\frac{1}{4}$	11.94 $\frac{1}{2}$	„	4.79 $\frac{3}{4}$	2.0 $\frac{1}{16}$	145.3	2.4 $\frac{1}{16}$	
Apr. 10.....	73 $\frac{1}{2}$	12.04	1.6 $\frac{1}{8}$	4.84 $\frac{5}{8}$	2.0 $\frac{1}{2}$	143.6	2.4 $\frac{1}{2}$	
„ 24.....	73 $\frac{1}{4}$	12.02	„	4.82 $\frac{1}{4}$	2.3 $\frac{1}{4}$	143.8 $\frac{1}{2}$	2.8 $\frac{1}{2}$	
May 8.....	72 $\frac{3}{4}$	12.03 $\frac{1}{2}$	1.6 $\frac{3}{4}$	4.84 $\frac{3}{8}$	2.4 $\frac{7}{8}$	144.0 $\frac{1}{2}$	2.8 $\frac{1}{2}$	
„ 22.....	74 $\frac{1}{4}$	12.20	„	4.91 $\frac{1}{2}$	2.5 $\frac{5}{8}$	141.11 $\frac{1}{2}$	2.10 $\frac{1}{16}$	
June 5.....	75 $\frac{3}{4}$	12.19	1.6 $\frac{1}{2}$	4.95 $\frac{3}{8}$	2.4 $\frac{1}{4}$	141.2 $\frac{1}{2}$	2.9 $\frac{1}{8}$	
„ 19.....	74 $\frac{3}{4}$	12.26	„	4.93 $\frac{3}{8}$	2.4 $\frac{1}{16}$	140.11 $\frac{1}{2}$	2.8 $\frac{1}{16}$	
July 3.....	74 $\frac{3}{4}$	12.21	1.6 $\frac{1}{8}$	4.94 $\frac{1}{8}$	2.2 $\frac{1}{2}$	141.6	2.7	
„ 17.....	74 $\frac{3}{4}$	12.28 $\frac{1}{2}$	„	4.96 $\frac{1}{2}$	2.1 $\frac{7}{8}$	141.0 $\frac{1}{2}$	2.6 $\frac{1}{8}$	
Aug. 7.....	74 $\frac{5}{8}$	12.30 $\frac{1}{2}$	1.6 $\frac{1}{8}$	4.96 $\frac{1}{4}$	2.0 $\frac{7}{8}$	140.5	2.6 $\frac{1}{16}$	
„ 21.....	75 $\frac{1}{4}$	12.34 $\frac{1}{2}$	1.6 $\frac{1}{8}$	4.98 $\frac{1}{4}$	1.11 $\frac{1}{2}$	139.11 $\frac{1}{2}$	2.5	
„ 28.....	75 $\frac{1}{4}$	12.35	1.6 $\frac{1}{8}$	4.97 $\frac{3}{4}$	1.11 $\frac{1}{2}$	139.11 $\frac{1}{2}$	2.5	
Sept. 11.....	74 $\frac{3}{4}$	12.28 $\frac{1}{2}$	1.6 $\frac{1}{2}$	4.94	2.0 $\frac{1}{2}$	140.9 $\frac{1}{2}$	2.5 $\frac{1}{8}$	
„ 25.....	74 $\frac{3}{4}$	12.25	„	4.92	2.0 $\frac{1}{2}$	141.1	2.5 $\frac{1}{8}$	
Oct. 9.....	74 $\frac{3}{4}$	12.18 $\frac{1}{2}$	„	4.91 $\frac{1}{16}$	2.0 $\frac{3}{4}$	141.10	2.5 $\frac{3}{8}$	
„ 23.....	74 $\frac{1}{4}$	12.22 $\frac{1}{2}$	„	4.92	1.11 $\frac{3}{4}$	141.4 $\frac{1}{2}$	2.5 $\frac{1}{8}$	
Nov. 6.....	74 $\frac{1}{4}$	12.24	„	4.91 $\frac{7}{8}$	1.6 $\frac{1}{8}$	141.4 $\frac{1}{2}$	2.5 $\frac{1}{8}$	
„ 20.....	74 $\frac{1}{4}$	12.24	„	4.92 $\frac{3}{8}$	1.5 $\frac{3}{8}$	141.4 $\frac{1}{2}$	2.5 $\frac{1}{8}$	
Dec. 4.....	74 $\frac{1}{4}$	12.27	„	4.93 $\frac{7}{8}$	1.4 $\frac{1}{2}$	140.11 $\frac{1}{2}$	2.5 $\frac{1}{8}$	
„ 18.....	74 $\frac{1}{4}$	12.24 $\frac{1}{2}$	„	4.92 $\frac{3}{8}$	1.3 $\frac{1}{2}$	141.3	1.11	

CORRIGENDA.

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Page 293, lines 26 and 37, *for* assays *read* arrays.

JOURNAL
OF THE ROYAL STATISTICAL SOCIETY
PART II, 1936.

THIRD MEETING OF THE SESSION 1935-36, 21ST JANUARY, 1936,
THE PRESIDENT, PROF. M. GREENWOOD, F.R.S., IN THE CHAIR.

THE CHAIRMAN, in opening the meeting, said that they met under the shadow of a national calamity. The magnitude of that loss would be displayed elsewhere by the leaders of the Nation; the President of a scientific Society could refer only to items, small in themselves, but significant to its members. Many who now heard him were present when in 1934 the new King honoured the Society by graciously receiving its guests from many nations. Perhaps a few might be there who more than thirty years ago were present when the Sovereign whom they now mourned performed a like office. They were but one of a great company of Societies and Institutions to whom King George gave ungrudgingly of his time and service. Every man's affairs were important to himself, as Johnson said; it was no labour to any of the Fellows of the Society to attend its meetings, and to discuss with their friends the subjects which interested them. But as they grew older and more prone to excuse themselves from uninteresting engagements, they might reflect upon the fact that three generations of the Royal House had spared time and thought for them, and they would number themselves among the millions whose gratitude and affection were not a ceremonial form of words, but a heartfelt emotion. He asked all present to rise, and so silently pay a tribute of affectionate respect.

THE RECENT TREND IN ENGLAND AND WALES OF MORTALITY
FROM PHTHISIS AT YOUNG ADULT AGES.

By A. BRADFORD HILL, D.Sc.

Introduction.

WE are now quite accustomed to read annually in the Registrar-General's Review of England and Wales that the death-rate from respiratory tuberculosis has reached a new low record, and the

enormous decline in the mortality attributed to this disease, over the past three-quarters of a century, is so well recognized that I need give it no more than the briefest of comments. It is sufficient to state that the standardized death-rate at all ages from tuberculosis of the respiratory system was 2,772 per million living in 1851-60, 768 in 1921-30 and 586 in 1934, or, expressed in ratios, the rate in

TABLE I.

England and Wales. The Mortality Rates per Million from Pulmonary Tuberculosis and Phthisis for each Decade from 1851-60 to 1901-10.

	All Ages Standardized.	0-	5-	10-	15-	20-	25-	35-	45-	55-	65-	75+.
MALES. Rates per million.												
1851-	2,694	1,333	526	764	2,308	4,051	4,028	4,016	3,810	3,346	2,894	927
1861-	2,612	994	433	608	2,190	3,894	4,111	4,170	3,880	3,312	2,037	663
1871-	2,359	787	342	483	1,683	3,109	3,713	4,137	3,865	3,206	1,928	604
1881-	1,906	553	254	344	1,294	2,341	2,037	3,577	3,505	2,920	1,823	690
1891-	1,633	441	174	234	995	1,887	2,369	3,095	3,144	2,618	1,584	556
1901- -10	1,358	351	137	171	756	1,321	1,966	2,446	2,733	2,379	1,521	567
Rates of each decade as percentages of rates in 1851-60.												
1851-	100	100	100	100	100	100	100	100	100	100	100	100
1861-	97	75	82	80	92	96	102	104	101	99	85	72
1871-	88	69	65	63	70	77	92	103	101	96	81	65
1881-	73	41	48	45	54	58	75	89	91	87	76	74
1891-	61	33	33	31	41	47	59	77	83	78	66	60
1901- -10	50	26	26	22	32	38	49	61	72	71	61	61
FEMALES. Rates per million.												
1851-	2,851	1,287	621	1,294	3,523	4,302	4,583	4,197	3,134	2,394	1,640	717
1861-	2,578	951	479	1,050	3,121	3,972	4,395	3,909	2,867	2,075	1,246	448
1871-	2,119	733	377	851	2,409	3,154	3,556	3,412	2,468	1,786	1,097	407
1881-	1,672	518	328	702	1,809	2,326	2,801	2,740	2,062	1,515	980	398
1891-	1,226	385	239	502	1,290	1,591	1,923	2,121	1,642	1,239	807	352
1901- -10	951	304	194	396	968	1,285	1,473	1,551	1,310	1,047	756	357
Rates of each decade as percentages of rates in 1851-60.												
1851-	100	100	100	100	100	100	100	100	100	100	100	100
1861-	90	74	77	81	89	92	96	93	91	87	76	62
1871-	74	69	61	66	68	73	78	81	79	75	67	57
1881-	59	40	53	54	51	51	61	65	66	63	60	56
1891-	43	30	36	39	37	37	43	51	52	52	49	49
1901- -10	33	24	31	31	28	29	32	37	42	44	46	50

1921-30 was only 28 per cent., and the rate in 1934 only 21 per cent., of that recorded in 1851-60. From the present point of view, a study of the recent trend of the phthisis mortality rate in young adult life, the aspect of this general decline in the death-rate that is of interest lies in the varying contributions made to the total by the different age groups.

Taking first the years between 1850 and 1910 the age specific death-rates for each sex in each decade are shown in Table I (these figures being extracted from the Registrar-General's Supplement to the 75th Annual Report). It will be seen that during this period of sixty years the standardized death-rate of males from pulmonary tuberculosis and phthisis (headings 28 and 29A in the 1911 List of Causes of Death) was halved, while for females the level in 1901-10 was only one-third of that observed in 1851-60. Examination of the figures at different ages shows clearly that this decline has not been equally spread, or anything like equally spread, over the span of life. For both sexes a considerably greater improvement took place in early life than at the middle and older ages. In the young adult stage of life there was for both sexes, but particularly for males, a decline in excess of that shown by the standardized rates. For instance, at ages 15-25 years the death-rate of males was in 1901-10 nearly one-third of the rate at the same ages in 1851-60, compared with the one-half for their standardized rate; the rate of females at ages 15-25 was in 1901-10 28-29 per cent. of the level in 1851-60, compared with 33 per cent. for their standardized rate. Over this period of sixty years the position of young adults of both sexes was, therefore, very favourable.

The rate of decline, as well as the total amount, shows variations with age over this period of sixty years, but it may be observed that in nearly every age group the fall has been continuous. The rate of decline in the young adult age groups is shown in Table II. For males at ages 15-20 and 20-25 there was a practically constant rate of improvement between 1861 and 1910. At 15-20 years each decade shows a fall of nearly one-quarter from the mortality figure in the previous decade, while at ages 20-25 years the fall is about one-fifth. At ages 25-35 years an increasing rate of decline is apparent up to the end of the nineteenth century and a slightly slackened rate in the first ten years of the present century. For females this latter trend is observed in each of the three age groups, namely, a somewhat increasing rate of improvement from 1851 to 1900 but a slackening off between 1901 and 1910. In spite of this slight decrease in the rate of improvement in the opening years of the twentieth century it is clear that the phenomenal decline in phthisis mortality amongst young adults of both sexes was unbroken for at

least sixty years. In striking contrast, therefore, is the position shown by the mortality returns for the years since 1910.

TABLE II.

England and Wales. The Mortality Rates from Pulmonary Tuberculosis and Phthisis in the Young Adult Age Groups, the Rates in each Decade being expressed as Percentages of the Corresponding Rates in the Previous Decade.

	15-	20-	25-35.
	MALES.		
1861-1870 as % of 1851-1860	92	96	102
1871-1880 „ „ 1861-1870	77	80	90
1881-1890 „ „ 1871-1880	77	75	82
1891-1900 „ „ 1881-1890	77	81	78
1901-1910 „ „ 1891-1900	76	81	83
	FEMALES.		
1861-1870 as % of 1851-1860	89	92	96
1871-1880 „ „ 1861-1870	77	79	81
1881-1890 „ „ 1871-1880	75	74	79
1891-1900 „ „ 1881-1890	71	68	69
1901-1910 „ „ 1891-1900	77	78	77

Owing to the peculiar conditions of the war period and its immediate aftermath, which produced a very considerable rise in the tuberculosis death-rate as measured on the civilian population, it has been essential to ignore the years 1915-20. The comparison set out in Table III is therefore between the pre-war years and the decade 1921-30 subdivided into smaller periods. The figures show that although amongst males in the young adult age groups, 15-35 years, the decline in mortality has continued it has been at a *slower rate (especially at ages 15-25) than is apparent in any other age group.* Amongst females there has actually been a *slight rise at ages 15-25, the death-rate throughout the decade 1921-30 exceeding that of 1901-10, while at ages 25-35 the decline is appreciably less than that observed in any other age group.*

Such is the position when the statistics for the whole of England and Wales are considered. When division of the country is made into groups of its administrative areas, important differences are found between the urban and rural courses of mortality. The figures in illustration are given in Table IV, where London, County Boroughs, Other Urban Districts and Rural Districts are separately dealt with. Clearly it is in the urbanized areas that the unfavourable change is most apparent. * In London the male mortality rate at ages 15-25 has in recent years dropped only very slightly; in 1927-30 its level was 91 per cent. of the value recorded in 1911-14,

TABLE III.

England and Wales. Mortality from Respiratory Tuberculosis since 1900.

Ages.	Death-rates per 1,000,000.				
	1901-10.	1911-14.	1921-24.	1924-26.	1927-30.
MALES.					
0-	351	259	160	156	141
5-	154	147	104	104	82
15-	1,120	1,006	1,010	913	847
25-	1,966	1,649	1,415	1,336	1,192
35-	2,446	2,098	1,656	1,573	1,441
45-	2,733	2,290	1,659	1,607	1,625
55-	2,379	2,128	1,449	1,332	1,267
65-	1,521	1,315	913	855	840
75+	567	509	337	282	328
FEMALES.					
0-	304	231	139	126	116
5-	292	278	223	201	151
15-	1,112	1,078	1,235	1,186	1,143
25-	1,475	1,265	1,185	1,117	1,081
35-	1,551	1,302	970	856	761
45-	1,310	1,100	746	649	588
55-	1,047	896	594	534	477
65-	756	656	478	399	375
75+	337	331	246	211	202
Death-rates in each group of years as percentages of rates in 1901-10.					
MALES.					
0-	100	74	46	44	40
5-	100	95	68	68	53
15-	100	90	90	82	76
25-	100	84	72	68	61
35-	100	86	68	64	59
45-	100	83	60	58	59
55-	100	89	61	56	53
65-	100	86	60	56	55
75+	100	90	59	50	58
FEMALES.					
0-	100	76	46	41	38
5-	100	95	76	69	52
15-	100	97	111	107	103
25-	100	86	80	76	73
35-	100	84	63	55	49
45-	100	84	57	50	45
55-	100	86	57	51	46
65-	100	87	63	53	50
75+	100	93	69	59	57

and in this age group in this area the amount of decline is much below that shown by any other age group. In the county boroughs and other urban districts the decline at ages 15–25 has been slightly greater than that shown in London, to 84 and 86 per cent. of their 1911–14 values, but again these are slower rates of decline than those

TABLE IV.

Mortality from Respiratory Tuberculosis (rates per million) in Administrative Areas between 1911–1930 (excluding War Years)

Age Group.	LONDON.				COUNTY BOROUGH.			
	1911–14.	1921–23.	1924–26.	1927–30.	1911–14.	1921–23.	1924–26.	1927–30.
MALES. Rates per million.								
0–	363	139	105	135	332	226	255	195
5–	159	89	99	72	192	136	128	108
15–	1,141	1,153	1,091	1,037	1,200	1,174	1,074	1,004
25–	2,098	1,544	1,458	1,325	1,922	1,566	1,466	1,347
35–	3,219	2,061	1,905	1,790	2,617	2,075	1,977	1,750
45–	3,694	2,461	2,232	2,247	3,069	2,107	2,131	2,171
55–	3,658	2,279	1,997	1,954	2,756	1,782	1,738	1,708
65–	2,566	1,603	1,420	1,423	1,711	1,148	1,145	1,149
75+	1,422	823	491	746	604	376	345	412
MALES. As percentage of 1911–14.								
0–	100	38	29	37	100	68	77	59
5–	100	56	62	45	100	71	67	56
15–	100	104	96	91	100	98	90	84
25–	100	74	69	63	100	81	76	70
35–	100	64	59	56	100	79	76	67
45–	100	67	60	61	100	69	69	71
55–	100	62	55	53	100	65	63	62
65–	100	62	55	55	100	67	67	67
75+	100	58	35	52	100	62	57	68
FEMALES. Rates per million.								
0–	301	160	98	100	312	176	184	178
5–	266	195	141	117	349	277	252	183
15–	926	1,223	1,137	1,189	1,209	1,336	1,309	1,263
25–	1,179	1,137	1,062	995	1,402	1,277	1,193	1,194
35–	1,579	1,036	841	768	1,577	1,088	977	877
45–	1,569	907	727	660	1,319	834	789	714
55–	1,276	754	675	568	982	638	606	572
65–	1,145	716	443	410	650	481	432	417
75+	590	424	298	289	340	241	239	189
FEMALES. As percentage of 1911–14.								
0–	100	53	33	33	100	56	59	57
5–	100	73	53	44	100	79	72	52
15–	100	132	123	123	100	111	108	104
25–	100	96	90	84	100	91	85	85
35–	100	66	53	49	100	69	62	56
45–	100	58	46	42	100	65	60	54
55–	100	59	53	45	100	65	62	58
65–	100	63	39	36	100	74	66	64
75+	100	72	51	49	100	71	70	56

TABLE IV (continued).

Age Group.	OTHER URBAN DISTRICTS.				RURAL DISTRICTS.			
	1911-14.	1921-23.	1924-26.	1927-30.	1911-14.	1921-23.	1924-26.	1927-30.
MALES. Rates per million.								
0-	233	141	122	127	131	95	76	74
5-	132	89	93	73	104	85	85	57
15-	924	920	837	794	792	807	686	590
25-	1,401	1,278	1,244	1,088	1,368	1,308	1,190	1,022
35-	1,696	1,401	1,354	1,255	1,319	1,143	1,062	1,026
45-	1,817	1,354	1,296	1,323	1,191	970	911	897
55-	1,767	1,248	1,090	1,057	1,139	850	807	672
65-	1,025	770	718	680	801	540	479	489
75+	367	280	217	259	309	208	233	215
MALES. As percentage of 1911-14.								
0-	100	61	52	55	100	73	58	56
5-	100	67	70	55	100	82	82	55
15-	100	100	91	86	100	102	87	74
25-	100	91	89	78	100	96	87	75
35-	100	83	80	74	100	87	81	78
45-	100	75	71	73	100	81	76	75
55-	100	71	62	60	100	75	71	59
65-	100	75	70	66	100	67	60	61
75+	100	76	59	71	100	67	75	70
FEMALES. Rates per million.								
0-	202	124	105	82	118	89	77	78
5-	255	208	191	142	220	173	166	131
15-	1,023	1,176	1,135	1,074	1,061	1,160	1,077	1,006
25-	1,152	1,114	1,059	1,016	1,302	1,177	1,122	1,050
35-	1,095	882	772	667	1,047	876	801	720
45-	913	657	551	512	801	620	540	472
55-	823	544	478	415	688	518	442	394
65-	571	437	377	358	546	415	368	334
75+	284	240	184	198	267	178	179	184
FEMALES. As percentage of 1911-14.								
0-	100	61	52	41	100	75	65	66
5-	100	82	75	56	100	79	75	60
15-	100	115	111	105	100	109	102	95
25-	100	97	92	88	100	90	86	81
35-	100	81	71	61	100	84	77	69
45-	100	72	60	56	100	77	67	59
55-	100	66	58	50	100	75	64	57
65-	100	77	66	63	100	76	67	61
75+	100	85	65	70	100	67	67	69

shown at any other ages. In the rural districts the decline has been still more, to 74 per cent. of the 1911-14 level, and this improvement does not differ appreciably from the general improvement in these rural areas between the ages of 15 and 55 years. In other words, the more urbanized environments record, in comparison with the rural areas a smaller amount of improvement in the death-rate from phthisis of males at ages 15-25 during the last twenty years.

Amongst females of these ages there has been in London a really heavy increase in phthisis mortality between 1911-14 and 1921-30, the level at the latter period being fully 25 per cent. above that of the former. In the county boroughs and other urban districts there has also been an increase in the mortality rate, not to the pronounced extent evident in London, but of the order of 5 to 10 per cent. In the rural areas the increase has been least of all, and in the most recent years, 1927-30, the rate is 5 per cent. below that of the immediate pre-war years. Amongst females the adverse movement has also extended to the age group 25-35 (though to a smaller extent), for in all areas the decline at these ages is considerably less than in any other age group, and this feature, Table I has shown, was not apparent between 1851 and 1910.

Generally, therefore, these figures show (a) that the retardation of the fall in the phthisis death-rate of young males and the increase in the death-rate of young females in recent years are emphasized in the urban areas, though the rural areas have not been exempt; (b) that the maximum of the ill effects at these ages (ignoring the abnormal years of war) was in 1921-23 and that *in more recent years there has been some improvement* in all areas; (c) that the level of the rates, even in the most recent years, and the absence of really material improvement at these ages, are clearly problems of considerable concern.

Explanations of the Lack of Decline in Young Adult Phthisis.

These features of the trend of the phthisis mortality amongst young adults in recent years have, naturally, not been overlooked, and a number of workers have discussed their causation. The facts are not in dispute, their interpretation has led to a certain amount of disagreement. For instance, Coutts* believes that "to a considerable extent, the recent relative increase of pulmonary tuberculosis in young adults is due to a larger proportion of persons reaching the young adult age without previously having acquired tuberculosis infection. It would appear that the success which has already rewarded our efforts to reduce the total amount of tuberculosis infection in the community has resulted in a smaller proportion of the population securing protection in childhood, so that they have to face the hazards of adolescent life with no acquired immunity."

Bardswell† is unable to accept this view. He points out that,

* Coutts, F. J. H. 1932. Nat. Ass. for the Prevention of Tuberculosis. *Trans. of the 18th Annual Conference*, pp. 46-62. "The Protection of the Young Adult against Tuberculosis."

† Bardswell, N. D. 1932. Nat. Ass. for the Prevention of Tuberculosis. *Trans. of the 18th Annual Conference*, pp. 63-70.

judging by the tuberculin test, the evidence is that the number of non-reactors amongst young adolescents is small. He is inclined to attribute the increased incidence among young women rather "to the strain and stress of competitive wage-earning, and the associated changes in their social life as compared with twenty-five years ago, at a time when physically they are unfitted for it." It is this factor, the occupational and environmental, which has, in general, had most stress laid upon it. For instance, Roatta* maintains that "a woman certainly enters into active life under the most unfavourable conditions. This occurs when her resisting power is at a low ebb. The increasing strain in our modern life, and the ever greater number of girls who at an immature age are obliged to support themselves, give a plausible explanation of this indisputable fact, that women manifest the greatest death-rate from tuberculosis in their first twenty years." Bound up with this hypothesis are the arguments of Watt† and Heaf,‡ the former placing the responsibility for the tuberculosis of the young adult mainly upon the neglect of the simple rules of health—"proper feeding, a considerable amount of exposure to the open air and a proper balance between rest and exercise," the latter maintaining that "the speed of life is greater. The youth of to-day does not lead the peaceful life that he did twenty or thirty years ago."

Knopf§ has preferred an indictment against the "craze for slimming" amongst young women, which he asserts involves both under-nourishment and chest restriction by tight bands. Other factors which have, inevitably, been suggested as of importance are to be found in the increasing use of tinned food, the alleged lack of green vegetables in the modern diet, and the flimsy attire of the modern young female.

There is, therefore, no lack of more or less plausible explanations of the phenomenon. It is the object of this study to determine as far as possible the statistical evidence for and against the two principal interpretations, namely, the absence of immunizing infection in childhood and the presence of new occupational-environmental risks amongst women, and to consider the possible importance of a third factor, internal migration, which has been briefly referred to in the Registrar-General's reports, but has, I think, had relatively little attention paid to it elsewhere.

* Roatta, G. B. 1930. *Journ. Canadian Med. Ass.*, 22, pp. 465-8. "Reflections on the Increasing Mortality from Tuberculosis in Women."

† Watt, J. 1932. *Nat. Ass. for the Prevention of Tuberculosis. Trans. of the 18th Annual Conference*, pp. 72-7.

‡ Heaf, F. R. G. 1932. *Ibid.*, pp. 81-4.

§ Knopf, S. A. 1928. *Journ. Amer. Med. Ass.*, 90, pp. 532-35. "Tuberculosis among Young Women. Present Relative Increase in the Morbidity and Mortality."

Absence of Infection in Childhood.

Coutts's hypothesis that the decline in the total phthisis incidence has resulted in less protection being secured in childhood and therefore has led to an increase in the death-rate in adolescence has, it has been pointed out, been objected to by Bardswell on the grounds that the tuberculin test suggests that the proportion of young adults who are non-reactors is small. There appears, however, to be very little satisfactory evidence for or against a declining incidence of sensitivity to tuberculin. The surveys carried out have been reviewed carefully by Hart.* Two studies made in America and one in Norway suggest a decline in sensitization incidence among children. Hart concludes that "further information is required, particularly in regard to large cities, such as Vienna, where extensive tubercularization is known to have been present formerly. There is no evidence that adults of the poorer classes have as yet been affected to any significant extent by a declining tubercularization, the few recent urban figures showing a large percentage of positives." Topley,† reviewing the results of tuberculin tests, and of *post-mortems*, writes that "we may then take it as proved that the great majority of us—those at least that live in civilized communities—are infected with tuberculosis before we reach adult life."

I have endeavoured to test Coutts's hypothesis statistically by taking the death-rate from all forms of tuberculosis at ages 0-5 years as a criterion of the amount of infection present in childhood in the community. If the childhood death-rate is high we can presume a high infection rate at this time of life and vice versa. Superficially, the movements of this measure in time are not seen to be related to the absolute or relative increase in young adult phthisis. Between 1851-60 and 1901-10 the death-rate from all forms of tuberculosis at ages 0-5 was halved; but during the same period the phthisis mortality at ages 15-25 fell by approximately two-thirds. The decline of the death-rate in childhood was accompanied by an enormous decline in the death-rate of young adults. To this it might, however, be objected, logically, that it is not until recent years that the infection in childhood, as measured by the death-rate, has reached a critically low level; that throughout the larger part of this period infection in childhood was sufficiently diffuse to ensure an equal amount of protection to the subsequent young adult generation, while finally it has reached a level which does not ensure a similar amount of immunity in young adults. Some support is lent to this hypothesis by the secular trend of the rates. Between

* Hart, P. D. 1932. *Med. Res. Council. Spec. Rep. Ser.*, No. 164. "The Value of Tuberculin Tests in Man."

† Topley, W. W. C. 1933. *An Outline of Immunity.*

the decades 1851-60 and 1871-80 the death-rate from all forms of tuberculosis at ages 0-5 years fell by only 10 per cent. of its 1851-60 level, so that presumably "protective infection" in childhood would have changed but little. In 1881-90, however, a more substantial decline in this 0-5 death-rate took place, so that it reached 78 per cent. of the 1851-60 level. Twenty years later, in 1901-10, the phthisis death-rate of young females, aged 15-25, first showed a slight slackening in its rate of decline, so that it might be suggested that in 1881-90 the critical level of earlier "protective infection" had been reached. In the next decade, 1891-1900, there was again a relatively small change in the 0-5 death-rate—it fell another 10 per cent.—but in 1901-10 a further heavy decline is recorded at this age (another 18 per cent.), so that in the first ten years of the twentieth century the rate at 0-5 years was only one-half that in evidence in 1851-60. Twenty years later, in 1921-30, we have an increased phthisis mortality amongst young females and a retarded rate of decline amongst young males. To this extent, therefore, there is a time relationship between the two variables. On the other hand, in the periods 1901-05, 1906-10 and 1911-14 there has been a progressive decline in the tuberculosis death-rate (all forms) at ages 0-5, the mortality in 1911-14 being approximately one-third below that registered in 1901-05. Yet this further decline does not appear to be leading to any further rise in young adult phthisis; in fact, Table III shows that the phthisis mortality at ages 15-25 has tended to fall between 1921 and 1930, whereas if "protective infection" in childhood has been continuously reduced below a critical level, an increasing, or at least a stationary, rate of phthisis amongst young adults in the years 1921-30 would be expected (unless some third factor, *e.g.* public health activities, has come into play in recent years to obscure the relationship).

A further test of the possible relationship was applied by studying the movements of the two rates, in childhood from all forms of tuberculosis, in young adults from respiratory tuberculosis, in thirty of the English counties. In these areas the fall in the death-rate in childhood between 1881-90 and 1901-10 was correlated with the movement of the young adult rate twenty years later, between 1901-10 and 1921-30. Owing to the change from registration to administrative counties in 1911 the rates for 1921-30 are not derived from precisely the same areas as those for 1901-10, but the thirty counties chosen were those in which the change of area was small and the error therefore unlikely to be appreciable. The rates and their movements over the selected periods are set out in Table V. For neither sex do these figures support the hypothesis that reduction of the death-rate in childhood has *per se* led to an increase

in the death-rate in young adult life. The correlation between the movements of the two rates was $+0.31$ for males and $+0.07$ for females, neither coefficient being significant. The result is, perhaps, more clearly shown in the following broader groupings of the counties.

MALES.			FEMALES.		
Number of Counties.	Death-rate from all forms of T.B. at ages under 5 years. 1901-10 as % of 1881-90.	Death-rate from respiratory T.B. at ages 15-25 years. 1921-30 as % of 1901-10. Average of Group.	Number of Counties.	Death-rate from all forms of T.B. at ages under 5 years. 1901-10 as % of 1881-90.	Death-rate from respiratory T.B. at ages 15-25 years. 1921-30 as % of 1901-10. Average of Group.
9	Under 50	75	7	Under 50	97
9	50-59	78	6	50-59	107
7	60-69	86	5	60-69	107
5	Over 70	86	12	Over 70	105

There is no significant evidence that in counties where the childhood death-rate has fallen most, the young adult rate twenty years later has tended to fall to a less extent, or to rise to a greater extent, than elsewhere (though with the males there is a slight suggestion that the young adult rate has fallen most where the child death-rate has fallen most).

The same type of test has been applied to thirty of the large county boroughs. The death-rate from all forms of tuberculosis at ages 0-5 years in 1911-13 has been correlated with the phthisis death-rate at ages 15-25 years in the same county boroughs in 1929-31, the latter period representing the extreme for which information was available at the time of calculation. It is possible that both rates may tend to be high in the same borough at the two dates through the action of general factors, hygienic, social status, etc., and thus obscure their inter-relationship. As criteria of these general factors two indices have been taken, namely, the infant mortality rate in the years 1921-30 and the proportion of private families living at densities of more than two persons per room in 1921. The partial correlations were computed between the 0-5 and 15-25 death-rates for a constant rate of infant mortality and a constant rate of overcrowding. The question asked is, therefore, Is there a relationship between the total tuberculosis death-rate at ages 0-5 and the phthisis death-rate at ages 15-25 sixteen to twenty years later in towns in which general health factors, as measured by the infant mortality rate and overcrowding index, are equal (presuming linearity of regression between the variables concerned)? Again the answer is no, since the partial

correlation coefficients with infant mortality constant are found to be -0.26 for males and -0.01 for females, and with overcrowding constant -0.05 for males and $+0.17$ for females, none of these values being significant.

A similar test was applied to the figures for the aggregate of urban districts and the aggregate of rural districts in each county of England (excluding Rutland and the Soke of Peterborough on account of their small size). For each of these aggregates were calculated (a) the death-rate of females at ages 15-24 from respiratory tuberculosis in 1929-33 (deaths in 1929-33 divided by census population of 1931); (b) the crude death-rate of females from tuberculosis of all forms in 1911-13 (deaths in 1911-13 divided by census population of 1911); (c) the infant mortality rate in 1929-31 (the average of the rates in 1929, 1930, 1931). Correlating the crude death-rate of females in 1911-13 (used as evidence of degree of infection present) with the young adult rate for females some twenty years later for a constant rate of infant mortality gives *positive* coefficients ($+0.26$ in the urban districts and $+0.58$ in the rural districts), and therefore no evidence of an earlier low death-rate being followed by a subsequent high rate in young adult life, but rather the reverse.

TABLE VA.

Immunization in Childhood and Subsequent Death-rates in Young Adult Life.

Coefficients of Correlation.

Area.	No. of Observations.	Variables Correlated.		Coefficients of Correlation.	
		(1).	(2).	Male.	Female.
English Counties	30	Death-rate from all forms of tuberculosis at ages under 5. Rate in 1901-10 as % of rate in 1881-90.	Death-rate from respiratory tuberculosis at ages 15-24. Rate in 1921-30 as % of rate in 1901-10.	$+0.31$	$+0.07$
Large County Boroughs of England and Wales.	30	Death-rate from all forms of tuberculosis in 1911-13 at ages under 5.	Death-rate from respiratory tuberculosis in 1929-31 at ages 15-24.	$+0.07$	$+0.29$
Aggregate of U.D.'s in each English County	46	Ditto with			
		(a) Infant mortality rate 1921-30 constant		-0.26	-0.01
		(b) Density of population 1931 constant		-0.05	$+0.17$
Aggregate of R.D.'s in each English County.	46	Crude death-rate of females from all forms of tuberculosis in 1911-13.	Death-rate from respiratory tuberculosis of females aged 15-24 in 1929-33.	—	$+0.51$
		Ditto with			
		Infant mortality rate 1929-31 constant		—	$+0.26$
	46	Crude death-rate of females from all forms of tuberculosis in 1911-13.	Death-rate from respiratory tuberculosis of females aged 15-24 in 1929-33.	—	$+0.58$
		Ditto with			
		Infant mortality rate 1929-31 constant		—	$+0.58$

These various coefficients are collected in Table VA. Of the material values—the first two and the six partial coefficients—only the final one passes the formal test of significance, and this shows a relatively high rate of young adult phthisis following a high “infection” rate as measured by the total female death-rate in earlier years.

Finally, the variability in the changes in mortality must be noted. For example, taking a few of the large county boroughs of Lancashire, differences of this order are apparent: in Blackburn the phthisis death-rate at ages 15–25 in 1929–31 exceeds that of 1911–13 by 19 per cent. for males and 15 per cent. for females; in Oldham, on the other hand, it has declined by 6 per cent. for males and 25 per cent. for females; in Warrington there is a rise of 22 per cent. for males and 27 per cent. for females, while in Rochdale there has been a decline of 33 per cent. for males and 41 per cent. for females; in Manchester and Preston the rates for males show the same trend, namely, declines of 11 and 14 per cent., but the rate for females shows a rise of 27 per cent. in Manchester and a fall of 8 per cent. in Preston.

It is probable that some of this variability is due to the fact that a period of three years is too short to prevent fluctuations in the rates due to relatively small numbers of deaths, but it is unlikely that this could be the whole explanation. It is difficult to believe that the chances of an immunizing infection in childhood have varied so much between one Lancashire county borough and another. In general the statistical evidence available (admittedly slender) does not suggest that the level of the phthisis death-rate amongst young adults in different areas of the country is materially due to different degrees of immunization in childhood.

Occupational Changes.

Preliminary to an examination of the changes in the proportion of young women occupied in different types of employment I have studied the trend of phthisis mortality in the large urban areas for each sex separately, comparing the course of the one with the course of the other. The figures show that there is an appreciable degree of correlation between the two trends. I took first the data for 73 county boroughs as existing in 1911 (i.e. the total 75 less Devonport and Plymouth, which were amalgamated in 1914). For each of these boroughs calculation was made of the death-rate from respiratory tuberculosis at ages 15–25 years in 1911–13 and in 1929–31 (in the first case deaths in 1911, 1912 and 1913 divided by the census population of 1911 were taken to be sufficiently accurate—deaths before 1911 were not transferred to usual place of residence, so that the inclusion of 1910 was not desirable; in

the latter case the figures for 1932 were not available at the time of calculation and the deaths of 1929, 1930 and 1931 were related to the census population of 1931). The rate in 1929-31 was then expressed as a percentage of the rate in 1911-13, the sexes being treated separately. Similar figures were computed for the metropolitan boroughs. These calculations gave the results set out in Table VI, from which it appears that the average death-rate of males has fallen slightly in both sets of areas, while with females there has been a small increase in the county boroughs and a considerable increase in the metropolitan boroughs. The variability,

TABLE VI.

The Change in Mortality from Respiratory Tuberculosis at Ages 15-25 in 73 County Boroughs and in 28 Metropolitan Boroughs between 1911-13 and 1929-31.

					Death-rate in 1929-31 as percentage of rate in 1911-13.	
					MALES.	FEMALES.
73 County Boroughs	{ Mean	...	...	...	88.9	104.3
	{ S.D.	...	...	...	41.3	41.5
	{ C. of V.	...	...	...	46.5	39.8
53 County Boroughs *	{ Mean	...	...	...	94.0	103.5
	{ S.D.	...	...	...	35.5	36.9
	{ C. of V.	...	...	...	37.8	35.7
28 Metropolitan Boroughs †	{ Mean	...	...	...	86.4	128.5
	{ S.D.	...	...	...	26.3	41.1
	{ C. of V.	...	...	...	30.4	32.0

* Excluding from the 73 those boroughs with less than 20 deaths in either sex in 1911-13.

† Excluding the City.

however, it is important to note, is very large. For instance, amongst the larger county boroughs (53 in number) there were seven in which the death-rate of males declined by one-third or more of its earlier level and six in which it rose by 30 per cent. or more. Similarly, for the females there were eight county boroughs in which the death-rate declined by one-third or more, and ten in which it rose by 30 per cent. or more. The explanation of the general trend of mortality from phthisis in young adults has, as already pointed out, to account for these very large variations from place to place. The correlation between the percentage changes for the two sexes over this period of time is as follows :

73 County Boroughs	+	0.60.	S.E.	0.12
53 " "	+	0.72	"	0.14
28 Metropolitan Boroughs	+	0.49	"	0.19

The observed regression is shown in Table VII. It is quite clear that there is an appreciable degree of correlation between the recent trends of the male and female death-rates. Where the female rate

TABLE VII.

The Change in Phthisis Mortality at Ages 15-25 between 1911-13 and 1929-31 in County and Metropolitan Boroughs.

Rate in 1929-31 as percentage of rate in 1911-13.					Mean percentage change in each group.	
FEMALES.					FEMALES.	MALES.
<i>73 County Boroughs.</i>						
Under 15	(2)	...	...	...	61	64
50-74	(13)	...	...	...	87	83
75-99	(20)	...	...	...	111	86
100-124	(16)	...	...	...	134	102
125-149	(10)	...	...	...	180	137
150+	(10)	...	...	...
<i>28 Metropolitan Boroughs.</i>						
Under 90	(5)	...	...	...	83	73
90-110	(4)	...	...	...	102	68
111-129	(10)	...	...	...	120	85
130+	(9)	...	...	...	176	103

* Number of boroughs in each group.

has shown the greatest rise there has been on the average a tendency for the male rate to rise also, or at least to show a slower rate of decline. This relationship must, I think, lead to the conclusion that some factor common to both sexes is at work, and it follows that the special occupational-environmental changes in female life which have been implicated are unlikely to be more than a partial factor. Such causes might have added to the less favourable trend of the female death-rate, but the correlation of the trend of the male and female death-rates must make us search also for some cause common to both sexes. The same conclusion follows, naturally, from the observation that in an appreciable number of boroughs the death-rate of males has risen between 1911-13 and 1929-31. The occupations of females cannot be the cause of this, unless it be argued that changes in environment lead the females to succumb to phthisis in greater numbers and to infect to a larger degree the males of the same ages.

Whether in fact changes in female occupations have contributed to the trend of their phthisis death-rates I have endeavoured to determine in the county boroughs.

Taking England and Wales as a whole the *total* volume of female employment, *i.e.* at all ages, has not increased in the twenty years between 1911 and 1931. In 1911 the percentage of the female population aged 14 and upwards which was occupied was 35·6, while the corresponding figure was 33·7 in 1921 and 34·2 in 1931—in other words, there has been a very slight decrease. On the other hand, at ages 14–24 there has been some increase in the proportion occupied—from 62·9 per cent. in 1911 to 63·1 per cent. in 1921 and 68·6 per cent. in 1931. The change is slight and if the “strain and stress of competitive wage-earning” is a factor in the phthisis death-rate of young adult females, we must look for its influences in changes of *type* of employment rather than in an increased *volume* of employment.

TABLE VIII.

Death-rate of Females aged 15–25 from Respiratory Tuberculosis and the Proportion of Women aged 14 upwards Recorded as Occupied.

	Mean.	S.D.	Correlation coefficient.	Correlation coefficient with infant mortality rate constant.
73 County Boroughs.				
1911-13. Death-rate per 10,000	12.45	3.17	} -0.0080	-0.0134
1911. Percentage occupied ...	36.85	9.40		
1929-31. Death-rate per 10,000	12.48	4.75	} -0.3764	-0.5094
1931. Percentage occupied ...	36.37	8.96		
Death-rate in 1929-31 as percentage of death-rate in 1911-13	104.27	41.46	} +0.2193	—
Proportion occupied in 1931 as percentage of proportion in 1911	99.38	9.26		
59 County Boroughs.*				
Death-rate in 1929-31 as percentage of death-rate in 1911-13	100.31	37.87	} +0.1308	—
Proportion occupied in 1931 as percentage of proportion in 1911	100.03	8.97		

* Excluding those with less than 20 deaths from respiratory tuberculosis in 1911–13.

In studying the changes in the county boroughs it is, unfortunately, only possible to use the figures for female employment at all ages 14 and upwards; the numbers employed in the age groups are

TABLE IX.
Classification used in Computing Numbers of Females Occupied in Three Main Groups in 1921 and 1931.

Excluded Workers.	Factory Workers.	Clerical Workers.	Domestic Workers.
I. Fishermen.	V. Makers of Bricks, Pottery and Glass.	XXII. Persons employed in Transport and Communication.	XXVII. Persons engaged in Personal Service.
II. Agricultural Occupations.	VI. Workers in Chemical Processes, etc.	XXIII. Commercial, Finance and Insurance Occupations.	
III. Mining and Quarrying Occupations.	VII. Metal-workers.	XXIV. Public Administration.	
IV. Workers in the Treatment of Non-metallic Quarries and Quarry Products.	VIII. Workers in Precious Metals and Electro Plate.	XXV. Professional.	
XXVIII. Builders, etc.	IX. Electrical Apparatus Makers and Fitters.	XXVIII. Clerks, Draughtsmen, Typists.	
XXVI. Persons engaged in Entertainment and Sport.	X. Makers of Watches, Clocks and Scientific Instruments.		
XXX. Stationary Engineers, etc.	XI. Workers in Skins and Leather, etc.		
	XII. Textile Workers.		
	XIII. Makers of Textile Goods.		
	XIV. Makers of Foods, Drinks and Tobacco.		
	XV. Workers in Wood and Furniture.		
	XVI. Makers of and Workers in Paper and Cardboard, etc.		
	XVII. Printers and Photographers.		
	XIX. Painters and Decorators.		
	XX. Workers in Other Materials.		
	XXI. Workers in Mixed or Undefined Materials.		
	XXIX. Warehousemen, Storekeepers and Packers.		
	XXXI. Other and Undefined Workers.		

not available in the 1931 census volume dealing with occupations. I have, therefore, first correlated the phthisis death-rate of females at ages 15-25 in the different county boroughs with the proportion of women aged 14 and upwards who were occupied. The results are given in Table VIII. In 1911-13 the phthisis death-rate shows no relationship whatever with the total volume of employment amongst women; on the other hand, in 1929-31 there is quite an appreciable, and significant, degree of relationship, but the county boroughs with *greater* proportions of females occupied have *lower* death-rates. Between the two periods insignificant changes have taken place in the average percentage of women occupied (36.9 and 36.4) and the variability from town to town has not materially changed (9.40 and 8.96). The average death-rate has risen slightly (from 12.45 to 12.48) and has become significantly more variable (3.17 to 4.75, a difference of 1.58 with a standard error of 0.47). Correlation of the percentage change in the death-rate with the percentage change in the proportion occupied gives a small positive coefficient, +0.22 if the 73 boroughs are considered and +0.13 if attention is confined to the larger boroughs, neither coefficient passing the test of significance. Changes in the *total volume* of female employment between 1911 and 1931 show, therefore, no material relationship to the changes in the phthisis death-rate at ages 15-25 in these county boroughs, though there is a slight suggestion that where employment has risen, young adult phthisis in females has tended to rise.

In testing whether changes in the death-rate can be ascribed to changes in *type* of employment one is limited to the material available in the census reports of 1921 and 1931. Differences in classification in 1911 make the figures not comparable with those of the later dates. From the figures of 1921 and 1931 I have computed the numbers in the groups given in Table IX. I think the three groups I have entitled factory, clerical and domestic are comparable at the two dates, and can be taken to represent broadly the different types of work in which females are occupied. In the 73 county boroughs previously dealt with, there has, taking them as a whole, been very little change in the proportions of women employed in these three groups. Table X shows that the proportions have risen slightly in clerical and domestic work and fallen slightly in factory work. Correlating the proportions occupied in the three groups with the death-rate shows a significant coefficient only in the domestic group, viz. -0.27 in 1921 and -0.31 in 1931. That the death-rate should be lower where the proportion of women thus employed is high seems a reasonable result, for the incidence of domestic service can be taken as a rough index of social conditions,

boroughs with a high proportion of domestics having higher proportions of persons in the more economically favoured classes. Keeping the infant mortality rate constant, this relationship, as

TABLE X.

The Occupations of Females and the Tuberculosis Death-rate in 73 County Boroughs.

		Mean.	S D.
Death-rate from respiratory tuberculosis at ages 15-25 per 10,000 females	1921-23	12.85	3.56
Percentage of women aged 14+ employed in :	1929-31	12.48	4.75
(a) Factory Group	{ 1921	15.45	11.60
	{ 1931	15.14	12.06
(b) Clerical Group	{ 1921	10.02	1.89
	{ 1931	10.53	1.86
(c) Domestic Group	{ 1921	9.94	4.76
	{ 1931	10.71	4.32
	1921.	1931.	1951, with Infant Mortality Rate of 1929-31 Constant.
Correlation coefficient between death-rate and percentage in :			
(a) Factory Group	-0.098	-0.146	-0.419
(b) Clerical Group	-0.006	-0.146	+0.010
(c) Domestic Group	-0.267	-0.314	+0.003

would be expected, disappears, but in its place is apparent a negative correlation between the death-rate and the proportion of women in factories; *i.e.* the higher the proportion of women of all ages 14+ in factories the *lower* the phthisis death-rate of young adult females. To this group is apparently due the association between the total volume of employment and the phthisis death-rate shown in Table VIII. If infant mortality is a sufficient indication of social and hygienic conditions, this relationship can hardly be due to towns with a large proportion of factory-employed women enjoying a higher economic status. It is, on the other hand, possible that towns in which factory occupations are available are those to which migration takes place.

This brings me to the third factor I wish to consider—internal migration. Before, however, leaving this limited discussion of occupational influences it will be as well to note that it takes no account, or no direct account, of the more general changes in social environment which have been implicated as factors in the rise in the death-rate of females. Of such changes we have no statistical measure, and as evidence “for the defence” one can only invoke,

as before, the variability in the movements of the death-rate from place to place. In Tables XI and XII the positions are shown for county boroughs (limited to those with over ten thousand females at ages 15-25 in 1911) and the metropolitan boroughs. Has the

TABLE XI.

The Change in the Phthisis Death-rate of Females from Respiratory Tuberculosis at Ages 15-25. 1911-13 and 1929-31. County Boroughs having in 1911 more than Ten Thousand Females in that Age Group.

Death-rate in 1929-31 as percentage of rate in 1911-13.	County Boroughs falling in each percentage group.
40-	Stockport.
50-	—
60-	Bradford, Halifax, Norwich.
70-	Huddersfield, Oldham.
80-	Burnley, Derby, Leeds.
90-	Bolton, Cardiff, Leicester, Stoke, Portsmouth, Preston.
100-	Brighton, Bristol, Croydon, Liverpool.
110-	Blackburn, Newcastle, Nottingham, Salford, Sheffield, Swansea.
120-	Kingston-on-Hull, Manchester.
130-	Birmingham, Gateshead, South Shields, Sunderland.
140-	—
150+	Birkenhead, Southampton, West Ham.

TABLE XII.

The Change in the Death-rate of Females from Respiratory Tuberculosis at Ages 15-25. 1911-13 and 1930-32. Metropolitan Boroughs.

Death-rate in 1930-32 as percentage of rate in 1911-13.	Metropolitan Boroughs falling in each percentage group.
70-	Hackney, Southwark.
80-	(Greenwich,* Holborn,* Stepney.
90-	Bermondsey, Bethnal Green.
100-	St. Pancras.
110-	Battersea, Islington, Paddington, Poplar, Shoreditch, Woolwich.
120-	Camberwell, Fulham, Hammersmith, Wandsworth, Westminster.
130-	Kensington, Lambeth, St. Marylebone.
140-	—
150-	Hampstead.
175-	Finsbury,* Lewisham, Stoke Newington.*
200+	Chelsea,* Deptford.

* Less than ten thousand females in the age group 15-25 in 1911.

“increasing strain and speed of modern life” so varied that it can account for a decline of 31 per cent. in the death-rate of Bradford

and a rise of 27 per cent. in Manchester, a decline of 20 per cent. in Derby and a rise of 30 per cent. in Birmingham, a rise of 35 per cent. in Lambeth and a decline of 12 per cent. in Stepney?

Internal Migration.

One striking aspect of the phthisis mortality of young adults in England and Wales (as well as elsewhere) has been repeatedly noticed, namely, the *higher* death-rates in the rural areas as compared with the urban areas, a characteristic not to be observed at any other age. In Table XIII a comparison of the death-rates is made between a group of eleven counties characterized as mainly urban and twenty-five counties characterized as mainly rural (figures from the Registrar-

TABLE XIII.

Death-rates from Respiratory Tuberculosis (rates per 100,000) in Urban and Rural Areas.

Age Group.	1891-1900.		1901-10.		1921-30.		Ratios of Rural to Urban Rates.		
	Urban Counties.	Rural Counties.	Urban Counties.	Rural Counties	All Urban Districts.	Rural Districts.	1891-1900.	1901-10.	1921-30.
MALES.									
0-	50.0	34.6	42.2	23.6	17.0	8.1	69	56	48
5-	21.6	18.1	16.7	13.6	10.1	7.4	84	81	73
15-	141.3	161.7	109.1	121.7	97.7	68.2	114	112	70
25-	244.8	226.9	195.9	204.9	133.3	115.5	93	105	87
35-	358.1	224.8	275.1	190.7	166.1	107.3	63	69	65
45-	379.8	211.6	333.0	183.9	181.1	92.3	56	55	51
55-	315.0	199.5	291.5	165.6	151.0	76.0	63	57	50
65-	190.7	134.9	189.5	117.4	99.7	50.0	71	62	50
75+	68.7	40.2	73.5	42.3	36.4	21.9	59	58	60
FEMALES.									
0-	43.1	30.1	35.4	22.8	13.8	8.1	70	64	59
5-	36.6	37.9	29.7	30.4	19.7	15.5	104	102	79
15-	136.7	176.2	105.6	137.5	120.7	107.4	129	130	89
25-	192.5	210.8	144.8	168.1	112.5	111.0	110	116	99
35-	233.1	184.9	166.6	138.3	86.5	79.1	79	83	91
45-	179.9	140.9	146.5	107.8	68.0	53.4	78	74	79
55-	131.3	115.5	114.8	96.4	54.9	44.2	88	84	81
65-	85.2	82.6	79.9	75.4	42.5	36.6	97	94	86
75+	41.9	31.6	43.6	30.6	23.0	18.1	75	70	79

General's Decennial Supplement, 1901-10; for list of counties *vide* that report, p. x, footnote). Both in 1891-1900 and in 1901-10 the phthisis death-rate of males at ages 15-25 is higher in the rural counties: 14 per cent. higher in the former decade, 12 per cent. in the latter. At ages 25-35 the death-rates in the two types of areas do not differ materially, while at all other ages the rural counties hold an appreciable advantage. In the same decades the

mortality rates of females from respiratory tuberculosis are slightly higher in the rural counties at ages 5-15 (4 and 2 per cent. excess), very much higher at ages 15-25 (29 and 30 per cent. excess) and substantially higher at ages 25-35 (10 and 16 per cent. excess). At all other ages the rural counties have lower death-rates than those in the urban counties.

The explanation of this somewhat curious position lies, it has been suggested, in the migration of young adults from the country to the town. Two hypotheses have been put forward: (1) that the young adult migrating from the country tends to acquire infection in the town and returns home to die, thereby swelling the death-rate recorded in the rural areas; (2) that the migrating population is a physically select group, so that the towns are strengthened by the addition of physically fit young adults at these ages, with the result that the urban death-rates are lowered in comparison with the mortality experienced by the weaker brethren left behind in the country areas. In a detailed study of the migration from the rural districts of Essex that I made some years ago * I gave some evidence in favour of this second hypothesis, namely, that relatively few migrants return home to die and that the greater part of the excess in the rural death-rates is more probably due to a population, weakened in its physical constitution by a selective withdrawal, succumbing to disease which some of the conditions of their life, e.g. diet, do not assist them to overcome. Waaler † has reached broadly the same conclusion for Norway. He states that "the circumstance that the figures for the country districts are higher than those for the towns in the age 21-30 (as regards the last twenty years) may be supposed to be merely a statistical phenomenon. As regards the towns it can be shown that there reside in them more persons between the ages of 21 and 30 than between 11 and 20. The population returns show an inflation in the number of persons between 20 and 30 years old which can only arise from immigration into the towns. As demonstrated by De Besche and Jørgensen ('Investigations respecting Mortality from Pulmonary Tuberculosis in Oslo amongst Immigrants and amongst the Native Population,' *Norwegian Journal of Medical Science*, 1925), there is in Oslo less mortality from tuberculosis amongst immigrants than amongst the native-born inhabitants. Of all deaths in the years 1921 and 1922 amongst native inhabitants aged from 15 to 40 years, 53.3 per cent. were due to pulmonary tuberculosis; amongst immigrants only, 34.2 per cent. Something similar is probably true as regards all Norwegian towns.

* Hill, A. B. 1925. *Med. Res. Council. Spec. Rep. Ser.*, No. 95. "Internal Migration and its Effects upon the Death-rates."

† Waaler, G. H. M. 1926. *Tubercle*, I, pp. 433-37. "Statistical Account of the Mortality from Tuberculosis in Norway."

Thus the towns receive by immigration a large number of persons (especially between 20 and 30 years of age) who are less liable to develop tuberculosis, whereby the mortality figures become in a way too low, at any rate lower than if we reckoned only with the native population. In the rural districts, on the other hand, there is left behind a comparatively large number of persons who die of tuberculosis, whereby the figures become too high. For it is reasonable to assume that those who are suffering from pulmonary tuberculosis, and who to a large extent will in three, four, or five years come to swell the returns of mortality from tuberculosis, do not move into the towns, whilst those who are healthy and therefore much less likely to die of tuberculosis will comparatively often immigrate into the towns."

There seems but little doubt that migration may be held responsible, if only in part, for this comparative aspect of the rural and urban phthisis mortality at these ages. Returning to Table XIII a comparison will be found between the death-rates from respiratory tuberculosis in all urban and rural districts in the decade 1921-30. At most ages, this comparison shows, there has been a relatively greater improvement in the death-rate in the rural districts—the basis of comparison, it must be noted, has been changed from *mainly* urban and *mainly* rural counties to urban and rural districts, the latter being probably a more accurate division of types. The most striking difference between the earlier decades and the later is, however, *the complete disappearance of the rural excess mortality at the young adult ages*. Whereas at ages 15-25 the rural rate for males exceeded the urban rate by 12-14 per cent. in 1891 to 1910, in 1921-30 it was 30 per cent. *below* the urban rate. (Table IV shows that the rural rate had fallen below the urban rate in the years before the War, 1911-14.) In the same age group the rural rate for females was 30 per cent. in excess of the urban rate between 1891 and 1910; in 1921-30 it has fallen to 11 per cent. below it. (Table IV shows that in 1911-14 the rural rate was still relatively high.) The excess mortality in the rural parts of the country at these ages has vanished. This conspicuous change may be the result of an increase in such adverse factors in the urban areas as some workers have postulated and which have been examined in the previous sections. The evidence, admittedly very incomplete and inexact, that I have given in these sections does not support those hypotheses. An alternative explanation would be that migration from the country to the town has slackened in recent years so that the young adult population of the towns is no longer strengthened by the addition of a physically select group. If that were true the rise in the death-rate in the urban areas would be in a sense,

at least in part, an artificial movement resulting merely from a change in the physical constitution of the populations at risk. It therefore seems to me of importance to determine as far as possible whether such a change has taken place.

That migration from the rural to the urban districts has diminished in volume, I believe there is no doubt. In a paper read before the Society in 1914, Professor Bowley * showed that in areas defined as the industrial regions the population increased in each decade between 1871 and 1901 by 15 to 20 per cent., whereas in the rural regions it declined by 3-3½ per cent. In 1901-11 the rate of increase in the industrial regions fell to 12 per cent. and the rural regions instead of showing a loss recorded an increase of 3 per cent.

Similarly, in the 1911 census report (Vol. I, p. xiv), the Registrar-General gives the rates of increase for a group of commercial and industrial counties and a group of agricultural counties. In 1891-1901 the industrial group increased by 13·4 per cent. and the agricultural group by only 1·9; in 1901-11 the corresponding rates were 11·8 and 6·2, showing a very much smaller difference between the rates of increase. Figures are also given in this report for 105 registration districts which at the census of 1911 were entirely rural. Tracing their population back it is found that between 1851 and 1891 they slowly but steadily lost population. Between 1891 and 1901 they began to increase, and between 1901 and 1911 they increased by 9·8 per cent. This change, and those referred to above, are not, of course, entirely due to a decline of migration at young adult ages—there was, in fact, in 1901-11 still a net loss of 1 per cent. by migration at all ages in the 105 districts—but the figures show a definite change in growth rates in the urban and rural areas dating from the turn of the century.

That changes in migration were a factor in Essex is shown in my study of that county. I studied the volume of migration (*i.e.* actual increase less natural increase) from twelve rural registration districts (ten in Essex plus one in Hertfordshire and one in Suffolk). I found that between 1831 and 1841 the net loss over the ten years was nearly 4,000 persons; this figure rose rapidly till in 1871-81 it reached over 44,000. Since that date it declined, to 30,000 in 1881-91, 24,000 in 1891-1901 and to *only just over* 2,000 in 1901-11. There is no doubt then that in these particular rural areas the net flow of population experienced a pronounced check in the first decade of the twentieth century. Looking at the figures from the urban aspect I found that the county borough of West Ham gained approximately 5,000 persons by migration in 1841-51, that this

* Bowley, A. L. 1914. *J. Roy. Stat. Soc.*, 77, p. 597.

figure increased with great rapidity to 132,000 in 1891-1901 and then fell precipitately to only 8,000 in 1901-11. On balance this area ceased to grow materially by migration at the turn of the century.

Coming to more recent years the census of 1931 shows that the great majority of county boroughs were *losing* population by migration between 1921 and 1931. In Table 2 of the census county volumes the increase or decrease by migration (actual increase minus natural increase) is shown for each administrative area as a percentage of the population in 1921 (changes of area between the censuses being taken into account). For the 73 county boroughs, the death-rates of which have been dealt with in the previous sections of this paper, I obtain the following distribution:—

Percentage Increase or Decrease by Migration. 1921-31.						Number of County Boroughs in Group.
Increase	{ 10 or more than 10 per cent.					3
	{ 5-9 per cent.					2
	{ 0-4 per cent.					13
Decrease	{ 0-4 per cent.					28
	{ 5-9 per cent.					17
	{ 10 or more than 10 per cent.					10

Only 18 towns have, on balance, gained by migration, while 55 have lost, half of the latter group having a net loss of 5 or more than 5 per cent. of their 1921 population. Of the 18 showing an inward movement only 5 had a net gain of as much as 5 per cent.

From the various figures presented above there can be no doubt that the internal movement of population has been in recent years radically different from that experienced in the latter half of the nineteenth century. It remains to be seen whether that change shows any relationship to the change in the phthisis death-rate amongst young adults. It must be observed that the changes in migration relate to the population at *all ages*, which are not necessarily true indices of the changes in migration at young adult ages. Taking them, however, as a rough index of population movements, I have computed the correlation coefficient between (1) the percentage change in the phthisis death-rate at ages 15-25 between 1921-23 and 1929-31 for both sexes combined, and (2) the increase or decrease by migration as given in the 1931 census volumes, for the 73 county boroughs previously dealt with. The coefficient found is -0.39 , a figure higher than that likely to arise by chance. In other words, the higher the population loss (recorded as a negative value) the greater the increase in the death-rate.

It will be remembered that there was an appreciable degree of correlation between the movements of the male and female rates, but the relationship was far from perfect. Similarly, the migration

rates may differ between the sexes. It is therefore important to determine the relationship between migration and phthisis mortality for the sexes separately. Owing to intercensal changes in areas it is laborious to calculate the migration rates in all the 73 county boroughs. I have, therefore, selected 28 in which the changes in total population due to change in area between 1921 and 1931 amounted to less than 2 per cent. of the 1921 population, a difference which, I think, may be neglected. The figures for these county boroughs are given in Table XIV. The correlation coefficients

TABLE XIV.

The Migration Rate at all Ages and the Change in the Death-rate at Ages 15-25 from Respiratory Tuberculosis in 28 County Boroughs. 1921 to 1931.

County Borough.	Males.		Females.	
	Migration Rate.	Change in Death-rate.*	Migration Rate.	Change in Death-rate.†
Reading	+ 0.8	45	+ 0.6	77
Birkenhead	- 9.2	80	- 6.9	116
Stockport	- 0.9	76	- 0.9	67
Gateshead	-12.3	113	-11.8	159
South Shields	-15.0	120	-11.9	116
West Ham	-12.1	102	-12.8	105
Bristol	- 0.1	105	+ 0.1	92
Bolton	- 4.1	77	- 2.8	92
Bootle	-11.8	98	- 9.0	93
Burnley	- 6.7	57	- 6.4	90
Liverpool	- 4.5	93	- 2.6	91
Manchester	- 1.0	75	- 0.6	96
Salford	-10.1	118	- 9.4	86
Leicester	- 2.9	74	- 3.0	87
Norwich	- 1.0	60	- 1.5	47
Newcastle	- 5.2	95	- 4.3	112
Nottingham	- 3.0	105	- 3.2	111
Portsmouth	- 8.9	149	- 4.4	113
Southampton	+ 2.2	86	+ 2.2	91
Croydon	+16.6	48	+15.8	87
Birmingham	+ 1.3	86	+ 1.1	113
Kingston-on-Hull	- 1.1	82	- 0.5	93
Middlesbrough	- 4.9	139	- 7.7	131
Bradford	- 0.3	103	+ 0.9	86
Huddersfield	+ 1.2	75	+ 3.1	63
Leeds	- 0.3	121	+ 1.0	83
Swansea	- 4.0	71	- 2.0	110
Newport	-13.1	135	-10.9	114
Average	- 3.94	92.43	- 3.14	97.18
S.D.	6.32	26.17	5.83	21.53
Correlation	-0.57		-0.51	

* Actual increase minus natural increase in 1921-31 as a percentage of the 1921 population.

† Death-rate in 1929-31 as percentage of death-rate in 1921-23.

between migration and change in the phthisis death-rate are -0.57 for males and -0.51 for females. It is clear that for both sexes the total gain or loss of population is significantly related to the movement of the death-rate. For each increase of 1 per cent. in the loss by migration the death-rate rises, *on the average*, by about 2 per cent., though the scatter round the regression line is, it must be noted, very large.

This measure between changes in the phthisis death-rate and the movement of the population is still only rough, since the latter relates to population at all ages. As a final test of the importance of migration I have made two attempts to assess its volume at ages 15-24 years. Using the county boroughs of Table XIV, I have computed for these ages the number of females in the population per 100 males in each county borough at the census of 1931. Where there is an excess of females it is assumed there has been an appreciable amount of female immigration; where females are in defect it is assumed that there has been less immigration. The measure is still rough, for it depends upon two variables—the male and female movements. For instance, an excess of females may not denote immigration of that sex but imply emigration of males; equality of the sexes may be the result of heavy immigration of both sexes or of no movement at all. Correlating this female/male ratio with the change in the 15-24 years' phthisis death-rate (1929-31/1921-23) gives values of -0.47 for males and -0.70 for females.

As a final, and I think somewhat better, measure of gain or loss of population I have worked as follows:—

(a) For each of the county boroughs of Table XIV the population of 1921 has been tabulated at each year of age 5 to 14, the sexes being differentiated.

(b) To reach the expected population in 1931 at ages 15-24 the recorded populations in 1921 at each age have been multiplied by the probability of surviving ten years ($_{10}p_x$). The probabilities that seem most appropriate have been calculated from the sectional tables given in the Registrar-General's Life Table report of 1921-23.*

(c) The difference between the observed and expected populations at ages 15-24 in 1931 has been expressed as a percentage of the observed population at these ages in 1921.

* Part I. Decennial Supplement, 1921. The values of $_{10}p_x$ are here available for (1) the county boroughs of Northumberland and Durham, (2) the county boroughs of Central Counties, (3) Greater London. The values from (1) were applied to Gateshead, South Shields and Newcastle; the values from (2) to Reading, Bristol, Leicester, Norwich, Nottingham, Portsmouth, Southampton, Birmingham, Bradford, Huddersfield and Leeds; the values from (3) to West Ham and Croydon, and the mean of the values of (1) and (2) to the remainder, namely, Birkenhead, Stockport, Bolton, Bootle, Burnley, Liverpool, Manchester, Salford, Kingston-on-Hull, Middlesbrough, Swansea and Newport.

(d) This migration rate has been correlated with the change in the phthisis death-rate at ages 15–24 (1929–31/1921–23).

The coefficients thus found are -0.45 for males and -0.71 for females, values practically identical with those reached by the sex-ratio measure. The observed trend of the death-rate in relation to migration is shown in Table XV. For each sex there is a fairly

TABLE XV.

The Migration Rate at Ages 15–25 and the Change in the Death-rate at Ages 15–25 from Respiratory Tuberculosis, 1921–1931.

County Boroughs.	Migration Rate.*	Mean Change in Death-rate.†
MALES.		
Gateshead, South Shields	More than 20% loss	117
Birkenhead, West Ham, Bootle, Burnley, Liverpool, Middlesbrough, Newport, Swansea ...	10–13% loss	97
Reading, Bolton, Salford, Newcastle, Nottingham, Portsmouth, Kingston-on-Hull	6–9% loss	96
Bristol, Leicester, Norwich, Stockport, Leeds, Southampton	1–5% loss	87
Manchester, Birmingham, Bradford, Huddersfield, Croydon	0–10% gain	77
FEMALES.		
Gateshead, South Shields, Middlesbrough ...	More than 18% loss	135
Birkenhead, West Ham, Bootle, Portsmouth, Newport	6–9% loss	108
Burnley, Salford, Newcastle, Swansea	0–2% loss	100
Reading, Bolton, Liverpool, Southampton, Kingston-on-Hull	0–4% gain	89
Birmingham, Stockport, Bristol, Manchester, Leicester, Nottingham	6–8% gain	94
Norwich, Croydon, Bradford, Huddersfield, Leeds	10–15% gain	73

* Ages 15–25. Actual population 1931—Expected population 1931 as percentage of actual population in 1921.

† Death-rate in 1929–31 as percentage of death-rate in 1921–23.

steady decline in the mean percentage change in the death-rate as the loss by migration changes to a gain. Round those means there is, of course, considerable variation, but it is clear that between the two variables there is a substantial degree of association. The highly urbanized areas which have continued to attract to themselves young adults have, on the average, shown a declining death-rate from young adult phthisis in the past decade, while those that have lost population have tended to show a rising death-rate.

If attention be transferred to the rural areas a similar association

is suggested by the figures, though to a considerably smaller degree than in the cities. For such areas the calculations were as follows:—

(1) For the aggregate of rural districts in each administrative county of England (excluding, on account of their small size, Rutland and the Soke of Peterborough) the death-rate of females aged 15-24 from respiratory tuberculosis was calculated for the periods 1921-23 and 1929-33 (using the deaths registered in those years and the census populations of 1921 and 1931).

(2) The death-rate in 1929-33 was expressed as a percentage of the death-rate in 1921-23.

(3) The sex-ratio (F. per 100 M.) at ages 15-24 in 1931 was calculated for the same areas.

Using this sex-ratio as an indication of female migration it was correlated with the change in the phthisis death-rate. The coefficient for the 46 aggregates was -0.48, whereas the corresponding procedure in the county boroughs gave a value of -0.70.

On the other hand, if the change in the phthisis death-rate be correlated with the percentage loss or gain of population *at all ages* between 1921 and 1931, as given in the 1931 census volumes,* no correlation is found, the coefficient being only -0.03 compared with -0.51 in the 28 county boroughs used previously. If instead

TABLE XVI.

Correlation between Changes in Mortality from Young Adult Phthisis and Measures of Migration.

Area.	Variables Correlated.		Coefficients.
	(1).	(2).	
73 County Boroughs	Death-rate from phthisis ages 15-24, both sexes. Rate in 1929-31 as % of rate in 1921-23.	Percentage loss or gain of population in 1921-31 at all ages.	M. and F. -0.39
28 " "	Ditto, distinguishing Males and Females.	Ditto, distinguishing Males and Females.	M. -0.57 F. -0.51
28 " "	" "	Ratio of Female to Male population in 1931 at ages 15-24.	M. -0.47 F. -0.70
28 " "	" "	Estimated migration rates in 1921-31 at ages 15-24.	M. -0.45 F. -0.71
46 Rural Aggregates	Death-rate from phthisis ages 15-24, females. Rate in 1929-33 as % of rate in 1921-23.	Ratio of Female to Male population in 1931 at ages 15-24.	F. -0.48
45 " "	" "	Percentage loss or gain of population in 1921-31 at all ages.	F. -0.03
45 " "	Death-rate from phthisis ages 15-24, females, in 1929-33.	" "	F. -0.28

* The two rural districts of Middlesex were excluded from this and from Table XVI, for the growth of their relatively small population by migration at the rate of +144.2 per cent. was utterly different from the experience of all the other aggregates of rural districts, and would have carried undue weight.

of the changes in the death-rate its absolute level in 1929-33 is used, the coefficient is -0.28 . The coefficients are collected in Table XVI.

The general uniformity of these coefficients leads, I suggest, to the conclusion that in recent years the level of mortality from phthisis amongst young adults in different types of administrative areas has been undoubtedly influenced, directly or indirectly, by the movement of population.

Indirectly the association might be due to the fact that towns that have ceased to attract population are in a less satisfactory economic position than those that still recruit young adults, and this lower economic position is reflected in their mortality. Similarly, rural areas that can now retain their young adult population may offer them an improved standard of living. On the other hand, the association may be a more direct one in the sense that in towns no longer recruiting physically fit young adults from the country areas we are measuring the mortality experience on a physically different population from that of past years. It must be observed too that the change in migration may not be only in its volume, which has been indicated above, but also in its type. Where migration to the towns has been maintained the type of migrating person may have altered. For instance, with regard to London the study of migration included in the *New Survey of London Life and Labour* led to the following conclusions:—"It seems legitimate to assume that during the decade 1921-31 the numbers of immigrants from the metropolitan counties fell, as those from the rural Midland and seaboard counties had fallen earlier; and on the other hand, the numbers from the Industrial North of England and South Wales increased rapidly, while the Industrial Midlands probably maintained an even position between the two contrasted groups. . . . Among the immigrants born in the provinces the urban-born from the industrial areas have tended to supplant those born in the south-eastern rural areas. London County is therefore becoming more and more a community born in urban surroundings. . . . The type of migrant whom London now attracts is not so much the low-paid agricultural labourer who expects to make his fortune, as the unemployed townsman of the 'depressed areas' who hopes to find a job."*

It seems, therefore, that we are measuring the phthisis mortality experience of London on a population of shifting type, and it is not unlikely that this is a factor of some importance in the trend of mortality, not only in London, but in other large urban aggregates. A similar factor operating to the advantage of the rural areas may lie in the addition to their population of persons of higher social

* *New Survey of London Life and Labour*, Vol. VI, pp. 227, 228 and 260.

class who, with the improvements in methods of transport, now find it possible to live in such areas though they work elsewhere.

It might, however, with much reason be argued that if the slackening of rural migration has unfavourably influenced the death-rates of the cities, a compensatory effect should have been apparent in those rural areas which now retain their young adults, and the young adult mortality of the country *as a whole* should not have been adversely affected. That argument suggests various points of importance. It may be that the population that now stays in the rural areas is not so well situated economically as when it was able to secure work in the towns—in other words, the problem of young adult phthisis lies not only in its rise in urban areas but also in the degree of its decline in rural areas, a decline which, taking into account the changes in migration, should have been greater than that which has been observed. An alternative explanation might be this. On the whole, urban conditions of life may be more favourable to the development of phthisis. In the past this tendency to a high phthisis death-rate has been masked by the recruitment of a more highly physically fit population which does not succumb to the environment. If this population largely ceases to come in and is partially replaced in the work that it carried out by less physically fit types, from within the area or from other urban areas, then the latter less resistant population may react to the environment so unfavourably that the resultant mortality in the towns is not balanced by the improvement in the rural areas consequent upon their retention of the previously migrating population. Finally, it may be that changes in migration are not the only factor influencing the trend of mortality at these ages. Personally I believe that it is unlikely that migration is the only factor, but the figures I have set out lead me to believe that it is at least a factor of importance and one which must be recognized in interpreting in specific areas the recent changes in the death-rate from phthisis amongst young adults of both sexes.

Summary.

The standardized death-rate from tuberculosis of the respiratory system was in the decade 1921–30 approximately only one-quarter of the rate recorded in 1851–60.

This enormous decline in mortality from phthisis has not been equally derived from the different ages of life. Between 1851–60 and 1901–10 the improvement observed was considerably greater in early life, ages 0–35 years, than in middle and old age. At the young adult ages, 15–25, the death-rate of males was in 1901–10

only one-third of the rate in 1851-60, while the death-rate of females was nearly as low as one-quarter.

On the other hand, between 1910 and 1930 a considerable change in the trend of mortality from phthisis amongst young adults has become apparent. In England and Wales as a whole the mortality at these ages has in these years declined amongst males at a slower rate than is apparent in any other age group. Amongst females there has actually been a slight rise in mortality at ages 15-25, the death-rate throughout the decade 1921-30 exceeding that of 1901-10, while at ages 25-35 the decline has been appreciably less than that observed in any other age group.

Division of the country into its administrative areas shows that it is in the urban areas that this unfavourable change is most apparent, though the rural areas have not been entirely exempt from it.

The maximum of the ill effects at the young adult ages (ignoring the abnormal years of the War) was in 1921-23, and in the years since then there has been an improvement in the death-rate in all the broad administrative divisions of the country.

Possible factors that may have played a part in this recent trend of the young adult death-rate in different parts of the country are:—

(1) A decline of immunization in childhood as a result of the fall in the general death-rate from tuberculosis producing a lower level of infection in early life;

(2) Changes in the occupational-environmental conditions of young adults, especially the entry of young females into new occupations;

(3) Changes in the regional distribution of population of young adult ages through the slackening of migration from country districts to the towns.

These hypotheses have been variously tested in turn.

(1) The death-rate from all forms of tuberculosis at ages 0-5 has been taken as a measure of the pressure of infection in childhood. Changes in this death-rate over a period of years in a group of English counties have not been found to be related to changes in the mortality at young adult ages in subsequent years. Similarly, towns with a high death-rate from tuberculosis at ages 0-5 do not appear to have a lower phthisis death-rate in young adult life fifteen to twenty years later than towns with a low death-rate in childhood—the general health factors being as far as possible equalized.

(2) Preliminary to the study of changes in female occupations, the trends of phthisis mortality for young adult males and for young adult females separately, in large urban areas, have been examined and compared. A considerable degree of relationship is found to exist between the changes in the male and female death-

rates in the county boroughs and the metropolitan boroughs over the years 1911-13 to 1929-31. Where the female rate has shown the greatest increase there has been, *on the average*, a tendency for the male rate to increase also or to show a slower rate of decline than in other towns. Where the female rate has declined substantially the male rate, on the average, has also declined substantially. This suggests that some factor common to both sexes is present and that the special occupational-environmental changes in female life are unlikely to be more than a partial factor.

The total volume of female employment in England and Wales has not changed appreciably between 1911 and 1931. The percentage of the female population aged 14 and upwards who were occupied was 35.6 at the census of 1911 and 34.2 at the census of 1931. At ages 14-24 there was some, but not a very large, increase, the percentages being 62.9 in 1911 and 68.6 in 1931. If the "strain and stress of competitive wage-earning" is a factor in the phthisis death-rate of young adult females its influence must, it seems, lie in changes of type of employment rather than its volume. Using the latter measure no significant correlation is found in the county boroughs over the years 1911 to 1931 between changes in the total volume of female employment and changes in the phthisis death-rate of young adult females.

Owing to census differences in occupational classifications the measures of change of type of employment have been limited to the narrow span of years 1921 to 1931. Taking three broad groups of occupations, factory work, clerical work and domestic work, it is found that in the county boroughs the proportion of women employed in these groups has not changed materially between 1921 and 1931. The phthisis death-rate of females aged 15-25 in these towns does not show, either in 1921 or in 1931, any appreciable degree of correlation with the proportion of females employed in factories or in clerical work, but tends to be low where the proportion of women in domestic service is high. This latter relationship is explicable on the grounds that where the proportion of women in domestic service is high, there exists a higher proportion of persons in the more economically-favoured classes whose death-rate from phthisis is relatively low.

(3) One striking aspect of the phthisis mortality of young adults in England and Wales in past years has been the *higher* death-rates registered in the rural areas as compared with the urban areas, a phenomenon observed only at the young adult ages. The explanation of this position lies, it is believed, in the migration of young adults from the country to the towns, and two hypotheses have been advanced: (a) that the young adult migrating to the towns tends to

acquire infection there and returns home to die; (b) that the migrants are a physically select group which strengthens the town population at young adult ages and leaves a physically weaker residue behind. There is some evidence available in support of the second hypothesis, but if either be true it would follow that changes in the volume of migration from country to town would be expected to produce changes in the regional distribution of the phthisis death-rate. In fact, in recent years, 1921-30, the excess mortality at the young adult ages in the rural areas has completely disappeared, while there is no doubt that in the present century the internal movement of population has been radically different from that experienced in the latter half of the nineteenth century. The loss of population (at all ages) in the rural areas has changed to a gain, and it appears that the rural exodus slackened at about the turn of the century. In more recent years the census of 1931 shows that the county boroughs themselves have lost population, probably in many cases by migration to suburbs outside their administrative boundaries. It is important to see whether these changes in the movement of population are, in fact, related to changes in the phthisis death-rate of young adults in different areas. For this purpose various measures of the loss or gain by migration, at all ages and at young adult ages, in the county boroughs between 1921 and 1931 have been correlated with the changes observed in the phthisis death-rate of young adults over these years. A substantial degree of correlation is found. Those county boroughs which have attracted young adults have, *on the average*, shown a declining death-rate from phthisis in young adult life during the past decade; those that have lost population have tended to show a rising death-rate. Figures for the rural areas suggest a similar relationship, though to a much less pronounced degree.

It is therefore concluded that in recent years the level of mortality from phthisis amongst young adults in different areas of the country has been to some extent influenced, directly or indirectly, by the movement in population, especially in the large urban areas. Indirectly the association might be due to the fact that towns that have ceased to attract, or have lost, population are in a less satisfactory economic position than those that still recruit young adults from other areas, and this lower economic level is reflected in their mortality experience. Alternatively, the association may be a more direct one; it may be that in towns that are no longer recruiting physically fit young adults from the rural districts we are measuring the death-rate upon a physically different population from that of past years—in fact, that the type of population exposed to risk in the different areas has changed. This change in type may be

more extensive than the measures of the volume of migration make apparent, since areas that continue to grow by migration may be attracting young adults, not from the country districts, but from the economically depressed areas. There is evidence that this change in the origin of the migrant has certainly taken place in London in recent years. In addition, the population in some rural areas may have changed in type owing to the improved methods of transport which enable persons to reside in such areas and work elsewhere.

If the present unfavourable position of the urban centres with regard to young adult phthisis is, at least in part, due to their lack of recruitment of migrants, it might be argued that a correspondingly favourable position should be shown in the rural areas. There certainly has been some decline in the mortality in the rural areas, but a decline that is less than that observed at other ages. On the other hand, evidence collected in my study of migration from the rural districts of Essex suggested that the migrants usually went to prearranged work in the towns and possibly to better economic conditions than those available in the home area. By remaining at home they may be running a higher risk of tuberculosis. Alternatively it may be that the work that has to be carried out in urban areas has now to be done by a less resistant population which reacts unfavourably to it. A lack of balance between the urban rise and the rural decline in the death-rate does not necessarily vitiate this hypothesis of migration being a factor of importance in the changes in young adult phthisis. If the hypothesis be a true one it would denote that the relative lack of decline in the rural areas (or in small urban areas if the flow of population has turned to them) is at least as important a problem as the rise in mortality in the towns.

It certainly seems unlikely that change in migration is the *only* factor influencing the trend of a form of mortality which is of complex causation, but the evidence suggests that it is a factor which, directly or indirectly, is of some importance, and must certainly be considered in the interpretation of the rates observed in specific areas.

DISCUSSION ON DR. HILL'S PAPER.

DR. PERCY STOCKS: I am glad that Dr. Bradford Hill, with his usual extraordinary industry, has been able to give us this very helpful paper. In several recent reports of the Registrar-General attention has been drawn to the retarded fall in the phthisis death-

rates of young adults, and it has been shown that this retardation was most pronounced in those towns and localities where social and economic conditions were least satisfactory. The main problem dealt with in Dr. Hill's paper is a very interesting one, and the difficulties of arriving at any direct explanation of it by means of the statistical material available are obviously very considerable, if not insuperable. It would be a great mistake, I think, to go away with the impression that the almost negative result of Dr. Hill's attempt to find a correlation between the tuberculosis mortality of children under 5 and the phthisis mortality at 15-25 in a period twenty years later has really disproved the hypothesis that diminishing exposure to infection in early childhood may result in a greater mortality in young adult life. The attempt Dr. Hill made was certainly worth making, but I think the insignificance of the correlation in Table VA might arise either from the inadequacy of the death-rate at ages 0-5 as a measure of the amount of infection to which children have been exposed or from some counteracting factors, of which there are no doubt quite a number. Thus it seems to me doubtful whether a greater fall in the average tuberculosis death-rate of children in a county or town over a period of twenty years, compared with that in another county or town, necessarily means a greater fall in the proportion of children being infected in the first area by the tubercle bacillus. There are so many social factors involved, such as migration, as Dr. Hill has shown later, and any of these may have had the effect of reducing or neutralizing such positive correlation as might arise from this particular cause. I think the proof or disproof of this hypothesis is really beyond the powers of any statistical analysis of the existing national data—mortality data, and the same applies to notification data. If it is to be solved, this question will have to be solved by some *ad hoc* investigation, and that would be difficult.

Turning next to the question of occupations, I am able to give some provisional recent figures which have some bearing upon the question. For simplicity I will combine the two uppermost of the five social classes, Nos. I and II, and also the next two, Nos. III and IV, making three main groups of occupations in descending social order, *i.e.*, I and II; III and IV; V. For males aged 20-25 the phthisis mortality per 100,000 in the three years 1930-32 was in these three groups 68, 104, 120, the corresponding rates from the previous census being 114, 138, 158. Thus the improvement for the three groups has been 40 per cent. for the first two social classes combined, 25 per cent. for the skilled and partly skilled group, and 24 per cent. for the unskilled workers.

At ages 25-35 the relative improvement has been very similar, namely, 40, 16, and 25 per cent. for the respective groups. If we turn to the wives of the men in these three social groups, we find the phthisis death-rates at ages 20-25 were 65, 104, 123, which are almost identical with those of the men, showing that the occupations in themselves cannot be responsible for the differences in these aggregate rates.

At ages 25-35, although the wives give lower rates than the men,

their rates have an even greater social range than the men's rates, namely, 55, 87, and 114, compared with 75, 109, and 121.

For occupied single women, divided into the three groups consisting of the same aggregates of occupations as for men, the rates at ages 20-25 were 69, 113, and 148, these being respectively 6 per cent., 9 per cent., and 20 per cent. higher than the rates of married women whose husbands were in the same social groups; but it must be remembered that the relative numbers engaged in the various occupations forming each group are widely different for men and women. The occupations of single women which showed the most striking numerical increases from 1921 to 1931 were domestic servants, clerks and shop assistants, all in social class III, and if increased employment of young women had been an important factor in retarding the fall in the phthisis death-rate, we should expect these occupations to have high phthisis rates. But if we compare the rates per 100,000 at ages 20-35, all single women give a rate of 125, social class III gave 111, domestic service 98, shop assistants in clothing and textile departments 98, clerks and typists 94. Therefore the three occupations which account for most of the increased employment for single women since 1921 have lower rates than the social group as a whole to which they belong, and much lower than the rate for all single women.

I think Dr. Hill has rendered good service in stressing the effects of the migration factor upon variations in mortality between one town and another. The importance of long-continued selective migration from the "depressed areas" on the death-rates, not only from phthisis, but also from other causes, *i.e.*, the effect of this migration on the death-rates of the population left behind, is not yet fully recognized, and will have to be taken into account in future studies. Between 1921 and 1934, 12 per cent. of the population of Durham and Northumberland and 15 per cent. of that of the South Wales region was lost by migration, whilst the South-east counties round about Greater London increased their population by immigration to the extent of 11 per cent. If the bulk of these migrants is being drawn from the most healthy part of the population—and I think in the case of the majority we must assume that it is—the effect on the death-rates must be considerable. In Table XV, Dr. Hill separates the towns registering a loss of females from those showing a gain between 1921 and 1931. Out of the 12 which showed a loss, 10 are in the "depressed areas," but out of the 16 showing gains, only 7 are so situated. We ask what are the reasons for an excess emigration from a town, the answer is—in the main the unsatisfactory economic conditions in that town, from which have resulted also unsatisfactory social conditions such as overcrowding. The correlation coefficient of -51 at the foot of Table XIV, between the improvement in the female phthisis death-rate and the excess of outward migration of females was therefore not entirely due to selection; in fact it *might* be entirely secondary to the high correlations between emigration and bad social conditions on the one hand and between phthisis mortality and bad social conditions on the other. I do not think it is entirely due to that,

but for the 28 towns given in the table the correlation between the fall in phthisis rate and the percentage of population living two or more per room is $-.62$, indicating an even closer relation with this social index than with the migration factor. The outward migration rate is also correlated with the overcrowding rate to the extent of $.56$.

We must therefore conclude that at least half of the correlation between migration and fall in the phthisis death-rate arises from the even greater negative correlation between fall in phthisis death-rates and bad economic conditions as evidenced by overcrowding, while the other half may well be due to selective migration of the fitter elements of the population.

The general conclusion seems to be that in producing the local differences pointed out, local social economic conditions of life on the one hand, and a selection produced by migration to new spheres of work on the other, are both important factors, but neither of these factors, nor yet the larger scale of employment of young women in shops and offices, can account for the retarded fall of phthisis mortality *in the country as a whole*, which was evident up to 1932. We are here trying only to account for the differential fall. It may turn out that this general retardation was only a temporary phenomenon, for the rates of recent years show a much more satisfactory trend: the percentage ratio based on 1901-10 rates, given in Table III, at ages 15-25, if continued for the four years 1931-34, would read,

Males	...	...	75	71	71	64
Females	...	...	100	96	94	89

so there has been a rapid fall recently.

I am now inclined to think that we have been witnessing a temporary aftermath of the shortage of fats, vitamins or other essential factors in diets during the years of food shortage 1916-18, which may have resulted in lowering the average resistance to tuberculosis as these children have been coming to adolescence and young adult life.

I have very great pleasure in moving this vote of thanks to Dr. Hill for his very stimulating contribution.

DR. UNDERWOOD: When I was asked to say a few words at this meeting, I had no idea that I was to be asked to second the motion for a vote of thanks. However, having been called upon, I do so with very great pleasure. I should like first of all to congratulate Dr. Hill on his contribution to this problem. The increased mortality from tuberculosis in young adults has received official recognition for some years, and Sir George Newman has repeatedly sounded a warning on this point. The question was further emphasized by the present Chief Medical Officer to the Ministry of Health, in his Report on Tuberculosis published a few years ago. The problem is a most elusive one, and most observers confine themselves to a general survey of the factors which may contribute to it. To my knowledge no information of the type Dr. Hill has given us has so far appeared, and he has at least cleared the air.

Referring to the first theory discussed by Dr. Hill—the possibility of immunization—I must admit that I have always been rather sceptical about the extent of immunization in tuberculosis, and especially of the strength of the evidence provided by tuberculin surveys. In diphtheria we are dealing with a disease in which the immunity level, though variable, fluctuates only within certain limits. According to current views, the measurable antitoxic factor contributes much more to the immunity against diphtheria than do the cellular factors which as yet cannot be accurately assessed. A Schick survey gives definite information about a community—information which is so accurate that it can be used to guide the course of administrative measures to combat diphtheria. On the other hand, it is widely admitted that with tuberculin the sensitization incidence of a population may indicate one of two things—either the proportion of persons who are infected at the time of testing, or the proportion who have been infected at some period of their lives. Despite this, I should be glad to have some results of the application of Dr. Hill's methods to the data for cities such as Vienna, in which there has been a considerable fall in the sensitization rate.

With reference to occupational changes, I am glad Dr. Hill has been able to bring in a verdict, perhaps not of Not Guilty, but at least a doubtful verdict against some of these factors. It has become easy for the legislator, the journalist or the lecturer to state in the press that modern conditions have caused the fall in the incidence of tuberculosis; yet although such statements may be useful from the point of view of social teaching, there is considerable doubt whether we can incriminate these factors in the case of tuberculosis. Take, for example, the question of housing. Wolff pointed out that in spite of the post-War shortage of houses the mortality from tuberculosis continued to decrease during this period.

Of the three theories, that dealing with migration is the one in which I was most interested. The implications of this theory are extensive, and I should like to pay further attention to them before coming to a definite decision. It seems to me that Dr. Hill has put forward much evidence that migration is an important factor. There are, however, several points which will have to be elucidated. For example, according to one theory mentioned in the paper, the migration from the country to the town means that the rural areas are depleted of their most fit inhabitants. I wonder if this is actually the case. I have an impression that, in certain areas at least, country-dwellers, who are otherwise fit, are liable to contract tuberculosis when removed into a strange environment, such as that of a large city.

There is another aspect of migration which has been comparatively neglected in the past, *i.e.*, migration, not as between town and town or country and town, but between two different parts of the same town. We are still comparatively ignorant of the relationship between organisms and their environment, but it seems to me that the rapid collecting together of a large number of persons from different areas, as for example on the opening of a housing estate,

or the development of a new suburb, may sufficiently upset the balance between parasite and host to precipitate the onset of disease.

If the migration theory is shown to be the main factor in keeping up the death-rate from tuberculosis in young adults, it will be desirable to initiate measures in factories and other work-places to ensure that the health of the migrant becomes a feature of special concern to the community.

I have much pleasure in seconding the vote of thanks to Dr. Hill for his careful and valuable paper

SIR LEONARD HILL said he would only like to express his astonishment that any son of his should have been able to carry out such a laborious piece of work in which such vast tables of figures appeared. He himself was an experimentalist, and he could no more put together such a paper than fly, but he thought he saw in him an environmental change due to his association with such men as the President. He was proud to say that the President had begun his scientific career with him, and his son had begun his scientific career with the President, and this paper was a result of that association.

He had had in mind to say what the mover of the vote of thanks had already said, that possibly the after-war conditions were of supreme importance; that during the war dietetic deficiencies in the food and the general strain of the war, combined with the great influenza epidemic which came after the war, might together have altered the young population to such an extent that the higher rate might be an aftermath of that, and he was glad to hear Dr. Stocks's view. Another point he had in mind was the improved conditions in the rural districts. It had to be remembered that there had been a great improvement in rural wages, and that the conditions of life of rural communities had been immensely improved since the war. These were the only two points he wished to make.

PROFESSOR GREENWOOD read a note received from Sir William Hamer, who had intended to take part in the discussion, but who was unfortunately laid up with a cold. Sir William wrote :

"I felt much honoured when I was asked to move a vote of thanks, for this is a most interesting paper, and I am sadly disappointed that a bad cold prevents my being here this evening. Nearly a quarter of a century ago, in 1912, I studied 'The Influence of Migration upon the Phthisis Death-rate,' and thus am greatly intrigued by Dr. Hill's 'Influence of Internal Migration.' Our President, in his Milroy Lectures on the 'Influence of Industrial Employment upon General Health,' referred to the above-mentioned address of 1912, and he continued, 'Perhaps what happens to an extreme degree when Dryden's noble savage becomes a townsman, happens to a less degree when Corydon repairs to the tenement, the picture palace and the factory.' Professor Greenwood would now doubtless be willing to add that the evil becomes intensified when neat-handed Phyllis abandons domestic service for office work. The domestic servant, who formerly was well-housed and well-fed and cared for, has now in many thousands of instances repaired to 'the

tenement, the picture house and the factory,' substituting scamped meals and late hours for good food and regular hours. The Annual Reports of London's Medical Officer of Health, during my last three years and since my retirement, have dealt with this serious state of things. Dr. Hill has taken great pains and spared no effort to throw, now, further light upon this post-war problem. The subject, moreover, was taken up with enthusiasm by Miss Bondfield, who did all she could to impress upon the young women of to-day the advantages, from a health point of view, of domestic service as compared with typewriting and clerical work in offices. Dr. Hill points out that while 'the total volume of female employment in England and Wales has not changed appreciably between 1911 and 1931,' the percentage of the female population aged 14-24 showed 'some, but not a very large, increase.' In *The New Survey of London Life and Labour* (p. 215) a footnote refers to 'a curious contrast . . . presented in the graphs for 5-15 and 15-25, during the years 1901-14 and 1921-27.' For females, 15-25, the rates were higher than those for 5-15, after the war, but generally lower in 1901-14. In males, in both pre-war and post-war years, the ages 5-15 compare favourably with 15-25. Dr. Hill finds that such anomalies, so far as females are concerned, lie in change of type of employment, rather than in its volume. Having read Dr. Hill's carefully argued and most instructive paper thrice, I sincerely hope a hearty vote of thanks will be accorded to him."

MR. STOCKMAN said he would like to have taken part in the discussion, but he had been working from a rather different aspect and had not had sufficient time to give to Dr. Hill's paper the study it deserved. He had found it extraordinarily interesting, but it was a paper he would wish to study a good deal more before attempting to speak upon it.

PROFESSOR GREENWOOD, continuing, said it was now necessary to put the vote of thanks to the meeting, and ask Dr. Hill to reply. He could not honestly say that he himself had anything of importance to add to the discussion. The particular problem that Dr. Hill had considered was of great interest. Even supposing the stagnation or deterioration of mortality at this age was ceasing—as, it was cheering to hear from Dr. Stocks, was the case—it was interesting to consider how far the effects were likely to be carried further through life.

Some Fellows would remember a very interesting paper read before the Institute of Actuaries by Mr. Derrick some years ago, on the generation method of looking at mortality, and since that time various statisticians had paid a good deal of attention to that particular problem. Cramér and Wold's elaborate comparison of the generation and period methods had just been published *in extenso* (*Skandinavisk Aktuarietidskrift*, 1935, p. 16).

Kermack, McKendrick and McKinlay two years ago contributed two papers applying not the same, but simpler methods, to British data. Professor Greenwood was disposed to agree that the Genera-

tion Method was, from the point of view of rough graduation, more effective than the period method. This he would not now discuss. But accepting for the moment the authors' biological explanation of their success, viz., that mortality rates at older ages were mainly determined by conditions of life experienced in later childhood, its application to the point under discussion was direct. It might be that the circumstances which produced unfavourable mortality from tuberculosis at 15-25 during a particular secular interval would have a repercussion in the future, that a wave would move down the age groups. If that *were* to happen, journalists and politicians would assuredly find a scapegoat not in the past, but the immediate present.

That brought him to another point of enormous value, in his view, in Dr. Hill's paper: the exact and careful use made of official data covering a long period of time. He hoped it was not entirely old age coming over him, but he was beginning to come to the pessimistic conclusion that not only did the general public not read official statistical documents, but younger members of the Civil Service who were not attached to Statistical Departments, were also imperfectly acquainted with the contents of even command papers dealing with population and vital statistical problems, and it might be that they could be persuaded at any rate to attend meetings of the Royal Statistical Society and read some of the papers published in the *Journal*. Dr. Hill had given an admirable example of how to extract and analyse information which he was afraid must be regarded as buried in official publications.

There was one final point, viz., the instructive comparison of the experience of this country with that of other countries. Some readers would have noticed a paper printed in the last issue of the *British Medical Journal* from a correspondent in Berlin, an accomplished statistician whom many Fellows would know, and they would have seen there a note on the most recent vital statistical experience of Germany, the Life-Tables based on the 1933 data. This point emerged, that, he thought for the first time in statistical history, German experience was slightly more favourable than British. The new British Table, when it came out, would, he thought, record a slightly lower expectation of life at birth than the German Table, due to a lower mortality in Germany at young adult ages. The German experience was rather less favourable at earlier childhood than ours, but for young adults of both sexes it was astonishingly favourable. He felt that one should rather emphasize the fact that it was very difficult for anyone to believe that economic and nutritional conditions in Germany since recovery from the complete slump of the inflation period had in truth been superior to the conditions of most of the population in Great Britain, and consequently when one was asked to draw direct sociological inferences from unfavourable mortality figures, it was necessary to draw attention to the possibility of very favourable figures in what, from the point of view of the journalist and the public generally, had been—and if one might judge from current reports, were still—economically, extremely unfavourable conditions. In fact, to draw

inferences from the vital statistical indices was, as Dr. Hill had pointed out in his paper, and Dr. Stocks had confirmed, an extremely difficult and delicate task, which made it all the more important that the public and some of their younger colleagues in the public Services should become a good deal more familiar with the bulk of evidence available than they seemed to him to be at the present time.

He now had great pleasure in putting to the Society that a hearty vote of thanks be accorded to Dr. Bradford Hill for the paper he had read. (Carried unanimously.)

MR. B. E. SPEAR sent the following remarks after the meeting:—

This is a disappointing contribution to a very intriguing problem in phthisis mortality. Owing to faulty methods of statistical treatment, it cannot be claimed that the conclusions set out in the summary have been *statistically* established.

In discussing any changes or contrasts in the phthisis mortality rates in the course of time, or in different areas, a standard or "control" of some kind or other must be set up. This is so in general, but particularly here, when the discussion is limited to a particular age-period and to the evaluation of specific factors to which the changes at that age-period might be assigned: the control which has proved to be generally reliable is that of the corresponding deaths from all causes. The validity of this control in the case of phthisis among adults rests upon the established fact that the determining factor in this disease is not infection, but resistance to infection. There is little in the nature of *specific* treatment of phthisis, and it is upon measures calculated to improve general health that Sanatoria mainly rely. Of the general health of a community we have no better measure than the general death-rate, especially at the principal phthisis ages.

A simple instance of the effect of a control on the apparent phthisis mortality rate will be found in the figures of Table XIII, in reference to which Dr. Hill observes that the *higher* death-rates in rural areas form a "striking aspect of the phthisis mortality." In my experience this higher phthisis death-rate is only apparent in figures which have not been corrected by distribution of the deaths according to place of residence instead of place of death. The figures before 1911 shown in the table were not so corrected, and show an excess of rural over urban death-rates among young adults, but not so the corrected figures of 1921-30. If the phthisis deaths had been stated per cent. of deaths from all causes, the rural percentage would have shown no divergent contrast with the urban, whether corrected figures were concerned or not. The late Dr. Brownlee, in a series of reports on the epidemiology of phthisis, published by the Medical Research Council, postulated the existence of a young adult phthisis, mainly in rural areas; a middle-age phthisis, mainly urban, and an old-age phthisis instanced in coal-miners.

Statistically those three types have no existence, as will be seen from the following figures showing the phthisis deaths per cent. of

deaths from all causes. I have added figures for stone-getters, dressers, etc., because here a specific factor is known to affect the rates, and its effect is clearly thrown up by the control used. In the case of occupational mortality rates, the influence of migration has to be borne in mind, but in general the control largely eliminates this factor.

(a) *Phthisis Mortality Rate at Stated Age-Groups in 1911-13 in the Rural Districts and County Boroughs of England and Wales: among Coal-miners (1910-12): and among Stone-cutters, Dressers, etc. (1910-12); and (b) the Phthisis Deaths Per cent. of Deaths from all Causes. Males.*

Age-group.	Rural Districts.		County Boroughs.		Coal-mining (excluding accidents).		Stone-cutters, etc. (excluding accidents).	
	(a).	(b).	(a).	(b).	(a).	(b).	(a).	(b).
15 ...	0.55	17.3	0.90	28.6	—	—	—	—
20 ...	1.15	34.5	1.33	38.8	0.81	32.1	1.02	41.6
25 ...	1.40	33.8	1.06	36.2	0.84	27.8	1.69	40.1
35 ...	1.35	22.2	2.63	27.1	1.02	19.9	3.40	40.9
45 ...	1.19	11.3	3.07	16.9	1.31	12.1	4.95	27.9
55 ...	1.17	5.1	2.75	7.5	1.43	5.1	5.25	14.7
65-75 ...	0.79	1.5	1.68	2.1	1.02	1.0	2.70	3.8

The effect of a control may be further illustrated by consideration of the figures quoted in the paragraph following Table VA. The following table compares the increase or decrease in the phthisis mortality among females aged 15-25 in 1929-31 upon 1911-13, as given by Dr. Hill, with the increase or decrease in the phthisis deaths stated as a percentage of deaths from all causes

County Borough.				Increase (+) or decrease (-) in the figures for 1929-31 over 1911-13. Females aged 15-25.	
				Phthisis deaths per 1000 of population (Dr. Hill's figures).	Phthisis deaths per cent. of all deaths (controlled figures).
Blackburn	...	...	...	+15	+22
Oldham...	...	...	...	-25	+12
Warrington	...	...	...	+27	+2
Rochdale	...	...	...	-41	-16
Manchester	...	...	...	+24	+27
Preston...	...	...	...	-8	+24

It is probable that the negative percentage of 16 shown for the controlled figures for Rochdale is due to smallness of the figures.

It is obvious that the use of the control figures in a partial correlation might give results radically different from Dr. Hill's coefficients.

The use of the post-war infant mortality as a criterion of differing hygienic, etc., conditions is difficult to defend. This rate has been

very unequally influenced by infant- and child-welfare work and, to a far greater extent, by the declining birth-rate, which does not appear to be dependent upon conditions of local hygiene, etc., at all. So too with regard to the use of the percentage of persons living more than 2 per room as shown by the 1921 census. In the years immediately following the war the housing conditions were abnormal, and in any case the small percentage of people living under these conditions is no general indication of hygienic, etc., conditions in a whole county borough (especially in Northern England). The calculation of partial coefficients on such inadequate criteria cannot possibly give any statistically acceptable conclusions.

I would like to draw attention to the continued misuse of the correlation coefficient in vital statistics. In this paper the death-rate from all forms of tuberculosis among children under 5 years of age is correlated with the phthisis mortality in the same area about *twenty years later*, among persons aged 15-25. It is difficult to see how this procedure can be justified when it is considered that the child mortality is largely due to bovine infection, while that of adults is almost entirely human. The assumption is that the distribution of the milk-borne infection is the same as the human infection, and that exposure to the former confers immunity against the latter—no proof of either assumption being given; and this material is made use of in partial correlations involving the unsatisfactory criteria previously referred to!

If it were proposed to a mathematician that he should deduce the correlation of a and d from two assays of the form $f(a, b, c)$ and $f(d, e, f)$ where a, b and c and d, e and f are variables which cannot be separately assessed, he would consider the proposal ridiculous. Yet there are instances without number in vital statistics where correlations are worked out on figures which are in fact of this complex form. The height of absurdity is reached when partial correlations are worked out on this kind of material as in this paper and, for instance, in another on the same subject by Dr. M. Greenwood, contained in the Annual Report of the Chief Medical Officer of the Ministry of Health for 1919-20, on the "procatactic" factors in the epidemiology of phthisis, in which figures are put forward showing the first and second partials between assays of this form. The result is a series of correlation coefficients far more difficult to interpret than are the "procatactic" factors they are presumed to illuminate!

The phthisis deaths increase relatively more than other causes of death during times of famine; and their percentage is also higher relatively in the lowest social grades. It has therefore been assumed that insufficient or unsuitable food or faulty nutrition is the cause of the increased phthisis rate, i.e., slimming (among young women), night life, underpay, etc. Instead, however, of seeking for some specified cause of this kind, it is perhaps more reasonable to ascribe the movement in the phthisis death-rate to adverse conditions affecting generally the younger adults and adolescents in these days.

The solution is apparently being found in early childless marriages.

The resulting depopulation of the country may perhaps serve

some occult political end, but would not the use of cheap money to develop the Colonies and populate them be wiser in the long run?

DR. BRADFORD HILL expressed his gratitude for the reception of his paper, and especially for the kind remarks that the proposer and seconder of the vote of thanks had made. He hoped at a later date to be able to reply to the various questions that had been raised.

His written reply is as follows:—

I wish to take the opportunity of reiterating my special thanks to Dr. Stocks for the trouble to which he has gone in considering my paper. I regard as most valuable both his additions to my figures and his comments upon the limitations of the latter. I fully agree with him that the factors involved in the regional movement and the regional distribution of the phthisis death-rates at different ages are doubtless so many that the isolation of any one factor and the accurate measurement of its effects are probably insuperable tasks. The most cogent statistical evidence against the theory of lack of immunization in childhood appears to lie in the recent trend of the death-rate at young adult ages. Table III shows an improvement in those rates during 1921 to 1930, and Dr. Stocks's later figures strongly emphasize that improvement. This fall has taken place in spite of the continued decline in the phthisis death-rate at all ages and in childhood. If the earlier fall in the latter rates—which is, I think, the only certain evidence we have of decreasing infection—led to the unsatisfactory position amongst young adults just after the war, we have now to postulate some potent third factor which is effectively more than counteracting that reaction. I find it easier to believe that in the country as a whole the retarded fall at young adult ages may be, as Dr. Stocks thinks, a temporary phenomenon, perhaps due, as he and Sir Leonard Hill suggest, to the conditions of the war.

Dr. Stocks's death-rates in occupational groups are very illuminating, and give additional support to my view that the evidence incriminating that factor is scanty.

In the interpretation of local differences in the movement of the death-rates I quite agree with him that social economic conditions of life may be important. Indeed, I pointed out in my conclusions that the explanation of the correlation between migration and the change in the death-rate might be due to the fact that towns that have ceased to attract or have lost population are in a relatively unsatisfactory economic position, and that this position is reflected in their mortality experience. At the same time I think he somewhat underrates the other aspect of the problem of migration. The selection may be produced not only "by migration to new spheres of work," but I think probably by a slackening of movement from the country to at least some of the large urban areas. The available evidence favours the view that this country element formed a strengthening of the town population at the migrating ages and, on the whole, was not, as Dr. Underwood suggests, more liable to contract tuberculosis. Any reduction in its size would therefore be likely to influence the death-rates unfavourably, especially if reinforced

in the depressed areas by the emigration of the physically fit and active.

The President referred to the possibility of a particular secular interval having unfavourably influenced the mortality at 15-25 which might pass in a wave down the age-groups. One can make a very slight test of that. The phthisis mortality at 15-25 was, Table III shows, at its worst in 1921-23, and if the wave passed to the age group 25-35 it ought to show itself in the most recent years. Actually at these ages in 1930-34 the death-rate from all causes shows no adverse movement, while from respiratory tuberculosis the rate of males was 53 per cent. and of females 66 per cent. of the rates in 1901-10, these figures satisfactorily continuing the decline shown in Table III.

Mr. Spear asserts that higher phthisis death-rates in rural areas are only apparent in figures which have not been corrected by distribution of the deaths according to place of residence instead of place of death. He makes no attempt to explain why this factor affects only the age-groups at which migration mainly takes place, and fails to observe the information provided in Table IV, which shows, in fact, that in 1911-14, *i.e.* after allocation of deaths to place of residence, the mortality rates of females at ages 15-25 and 25-35 in the rural districts were still higher than the corresponding rates in London and in other Urban Districts, though below the rates in the County Boroughs. If he will extend his experience to my study of Internal Migration and its effects upon the death-rates, he will find that the mortality from *all causes* was also higher in the rural than the urban districts of England and Wales amongst females aged 20-30 in 1911-14, and that the mortality of males in rural districts, though higher than that of the urban districts, most closely approximated to the latter at these ages (ignoring the old age-group above 80 years). Allocation of deaths is, I believe, quite incapable of explaining this feature of young adult mortality.

Mr. Spear's objection to the use of the death-rate from tuberculosis at ages 0-5 because it is "largely due to bovine infection" (a statement for which he gives no evidence) is only valid if bovine infection affords no protection against human infection, a view which, I understand, the bacteriological evidence does not support. Also I see no reason to believe that the differential fall in the death-rate in the areas dealt with is likely to be due mainly to differential changes in the incidence of tuberculosis of such origin. On other grounds—as put for ward by Dr. Stocks—I think the death-rate at these ages may not be an effective measure of the infection-rate, but in the absence of any other measure of the latter I was interested to see whether any positive result could be reached by means of it. The presence of a positive result would have given some support to the lack of immunization hypothesis; its absence certainly does not conclusively disprove it.

With regard to the remainder of Mr. Spear's contribution, I need only say that I share neither his enthusiasm for proportional rates nor his fear of correlation coefficients as broad measures of association, direct or indirect. I am aware that the presence of

numerous factors, and the inevitable adoption of inexact measures of them, make it difficult to interpret the results; but I personally prefer the attempt (made with due caution, I hope) to the facile and, to me, meaningless incrimination of "adverse conditions affecting generally the younger adults and adolescents in these days," or to the adoption of "solutions" which are equally unintelligible.

As a result of the ballot taken during the meeting the candidates named below were unanimously elected Fellows of the Society :—

Professor Torleiv Hytten.
The Rt. Hon. Lord Kennet of the dene.
David Burnett Meek.
Gilbert Jocelyn Ponsonby.

Corporate representatives.

M. Kantorowitsch, Ph.D., *representing* The Jewish Health Organisation of Great Britain.
William Twiston Davies, M.C., and Charles Frederick Sharman, M.A., Ph.D., *representing* The Imperial Tobacco Company, Limited (of Great Britain and Ireland).

SOME STATISTICAL ASPECTS OF FUTURE TRADING ON A
COMMODITY EXCHANGE.

By G. RONALD WHITE, M.A.

[Read before the ROYAL STATISTICAL SOCIETY, Tuesday, February 18th, 1936,
the PRESIDENT, PROFESSOR M. GREENWOOD, F.R.S., in the Chair.]

Introduction.

FUTURE trading in grain and cotton has been an established practice for upwards of 70 years. The widespread speculation of the American Civil War and the development of the fast steamship and telegraph, resulting in the rapid transmission of news and the consequent reaction in prices, caused merchants to seek for some method of reducing their risks. Numerous experiments were made before a futures contract comparable with the present-day form was evolved, but, once established, future trading spread rapidly on both sides of the Atlantic. For many years, however, the practice was confined to grain and cotton, and although futures markets now exist in a large number of other commodities, including coffee, cocoa, sugar, butter, eggs, pepper, cottonseed oil, rape oil, linseed oil, shellac, wool tops, hides, rubber, silk, jute, and non-ferrous metals, future trading in the majority of these has only commenced within the last ten years.

A future has been defined as "a contract for the future delivery of some commodity without reference to specific lots, made under the rules of some commercial body, in a set form, by which the conditions as to the unit of amount, the quality, and the time of the delivery are stereotyped, and only the determination of the total amount and the price are left open to the contracting parties." * Thus if A. buys 5 July contracts on the New York Cotton Exchange on February 1st at 10.50 cents per lb., he will expect to be able to take delivery from a licensed warehouse in New York or one of a number of Southern ports specified in the contract, between the first and last delivery days of July, of 250,000 lb. (a contract is 50,000 lb. in about 100 square bales) of a certain grade or grades of cotton on a basis of 10.50 cents per lb. for Middling, with additions or deductions for other grades in accordance with the provisions of the United States Cotton Futures Act, and allowance for staple premium *unless* he offsets such a purchase by the sale of 5 July contracts before he is due to take delivery. The fact that so many

* Professor H. C. Emery, *Speculation on the Stock and Produce Exchanges of the United States*.

purchases are offset by subsequent sales or vice versa, with the result that the total amount of a particular commodity which is actually delivered against exchange contracts is only a small proportion of the total volume of business transacted on the exchange, has led opponents of the system to denounce it on the grounds that it facilitates speculation and gambling in commodity prices. Another argument used by opponents of future trading, particularly in the earlier days, has been that "short selling," which is made possible by the exchange, depresses prices.

On the other side of the picture supporters of the system maintain that future trading :—

- (a) provides a continuous market ;
- (b) reduces major fluctuations in prices ;
- (c) brings prices in the chief markets of the world into line ;
- (d) facilitates the marketing of large seasonal crops ;
- (e) provides a system of price insurance by means of "hedging" operations, thus transferring the risk of price fluctuations from the producer, merchant or manufacturer to the professional speculator ;
- (f) enables handling charges to be reduced, and hence secures a higher price to the producer ;
- (g) assists in the financing of business, since the banks are always ready to lend up to a larger proportion of the market value of a commodity if this has been hedged than otherwise ;
- (h) provides a uniform system of trading.

The opposition to future trading, particularly in grain and cotton, has led to many investigations both by government commissions and independent bodies, among which may be mentioned the U.S. Federal Trade Commissions on the grain trade* and the cotton trade,† the Canadian Commission on Trading in Grain Futures‡ under the Chairmanship of Sir Josiah Stamp, the British Association Committee on Future Dealings in Raw Produce,§ and the International Chamber of Commerce Committee on Trading in Futures.|| Some of these investigations have included a certain amount of statistical

* Federal Trade Commission, Report on the Grain Trade, Washington, 1920-26.

† Federal Trade Commission, Report on the Cotton Trade, Washington, 1924.

‡ Dominion of Canada, Report of the Commission to Enquire into Trading in Grain Futures, Ottawa, 1931.

§ Proceedings of the British Association for the Advancement of Science, Section F, Bradford, 1900.

|| International Chamber of Commerce, Brochure No. 81, Trading in Futures (Commodity Exchanges), Paris, 1933.

analysis of future trading, while further statistical work has been carried out by individuals, including two papers read before the Society by R. H. Hooker in 1902 ("The Suspension of the Berlin Produce Exchange and its Effect upon Corn Prices"), and Professor S. J. Chapman and D. Knoop in 1906 ("Dealings in Futures on the Cotton Market"). Such work, however, has been confined almost exclusively to trading in grain and cotton. The reasons for this are obvious; the grain and cotton Exchanges are the oldest futures Exchanges, and the bulk of the controversy regarding future trading has raged around these institutions, while the volume of statistical material available is much greater than in the case of other commodities.

It is no part of my purpose to discuss the conclusions which have been arrived at by these various investigations. The fact remains that not only has future trading in grain and cotton become a world-wide practice, regarded by many sections of the trade as indispensable to the conduct of their business, but the system has spread to many other commodities. The question naturally arises whether the adoption of future trading in any of these commodities has been of real benefit to the trade concerned. It is impossible in the course of a single paper to investigate this problem for more than one commodity, and I shall confine my attention to future trading in hides.

Requirements for Future Trading.

Not all commodities are suitable for being the subject of future trading. In the first place, the commodity must be homogeneous in character and quality, *i.e.* the different units of the same commodity must bear to one another a high degree of uniformity or similarity. Secondly, the commodity must be susceptible of grading. Thirdly, it must be sufficiently durable to be stored for considerable periods of time. Fourthly, the volume of trade must be large in order to give a broad market, and the market must be uncontrolled. Hides are produced in every country in the world, but there is a wide range of variation in the character and quality of hides from different countries. Two of the largest producers are the United States and the Argentine. The bulk of the hides in these two countries come from animals which are slaughtered in the large meat-packing establishments. When graded, these hides are considered to be sufficiently uniform within each grade to fulfil the requirements of a futures contract, and the supply from these two sources alone is sufficiently large to meet all possible requirements for delivery against exchange contracts. Hides suitably stored can be kept in condition for a considerable time. The

founders of the New York Hide Exchange* considered that hides stored in a licensed warehouse could be regarded as "good delivery" up to seven months after certification, and this period has subsequently been extended first to one year and later to two years. Hides being a by-product, the supply is governed by the demand for the primary product, meat, and in comparison with grain, cotton, coffee, rubber, etc., is relatively stable. Demand, on the other hand, varies appreciably, with the result that hide prices have always been subject to wide fluctuations (average monthly prices of a typical hide over the period 1923-35 are shown in the diagram facing p. 304). The market for hides is a world market, practically every country being a consumer of hides. In the opinion of the founders of the Exchange, therefore, the chief requirements for future trading were fulfilled.

Trading on the New York Hide Exchange commenced on June 4th, 1929. The trading unit is 40,000 lb. (5 per cent. more or less) of wet-salted hides, the basis grade being No. 1 Packer Light Native Cows of July-August-September take-off. Hides vary in quality according to the time of the year when the animal is slaughtered, those taken off animals slaughtered in the months of July, August and September (as far as the United States is concerned) being in the best condition, *i.e.* containing more leather-producing substance per lb. of hide than those taken off in other months, the poorest quality being hides of January-March take-off. Hides of October-June take-off may be delivered against an Exchange contract at fixed discounts, while other grades of American and Argentine hides are deliverable at premiums and discounts as determined by the Adjustment Committee of the Exchange.

Magnitude of Business on the Exchange.

The annual consumption of hides in the United States alone during the three years prior to the opening of the Exchange averaged 21 million hides, of which more than half were of grades which would have been deliverable against an exchange contract. Table I shows (A) the volume of trading on the Exchange since its inception, giving the number of contracts and the equivalent number of hides taking an average of 750 hides to a contract (for the basic grade the

* The Exchange was originally incorporated in December 1928 as the New York Hide and Skin Exchange, the name being changed to the New York Hide Exchange before trading actually commenced. In July 1933 the Exchange was merged with three other futures Exchanges, the Rubber, National Metal, and National Raw Silk Exchanges, to form Commodity Exchange Inc., each of the four markets, generally speaking, maintaining its previous identity. To avoid confusion the Hide Futures Market is always referred to in this paper as the New York Hide Exchange.

TABLE I.

(A) *Volume of Trade on the Hide Exchange.*

Year.	Number of Contracts.	Equivalent Number of Hides.
1929 (June-Dec.)	4,129	3,100,000
1930	9,574	7,200,000
1931	13,662	11,700,000
1932	8,059	6,000,000
1933	7,682	5,800,000
1934	13,108	9,800,000
1935	18,166	13,600,000

(B) *Number of Contracts for each Delivery Month and Number of Transferable Notices issued 1931-35.*

Delivery Month.	Number of Contracts.	Transferable Notices Issued.	
		Number.	Per cent. of Total Contracts.
1931			
January *	39	—	—
May	4,468	92	2.1
September	3,517	38	1.1
December	2,745	37	2.1
1932			
March	3,053	43	1.4
May *	75	60	80.0
June	4,077	173	4.2
September	2,056	23	1.1
December	1,772	36	2.0
1933			
March	1,784	51	2.9
June	1,243	43	3.5
September	2,155	223	10.3
December	477	9	1.9
1934			
March	2,271	19	0.8
June	1,721	20	1.2
September	1,950	39	2.0
December	1,620	126	7.8
1935			
March	2,908	341	11.7
June	8,131	253	3.1
September	6,547	201	3.1
December	3,997	183	3.1

* Activity in the January 1931 and May 1932 futures declined very early in the "life" of the future. In the first case all sales were offset by subsequent purchases and no actual deliveries took place, but in the second case most of the contracts were not offset by opposite transactions, and actual delivery was effected.

figure would be higher, but for certain grades it would be less than 750), and (B) the number of contracts for each active delivery month * over the past five years together with the number of transferable notices † issued, and the latter expressed as a percentage of the former, indicating the proportion of total sales on the Exchange which culminated in actual delivery of hides.

The volume of business transacted on the Exchange bears a much smaller relation to the total consumption than in the case of commodities like grain and cotton, but it should be pointed out that the number of intermediaries between the producer and consumer, and hence the number of times when use might be made of the Exchange in connection with a specific quantity of the commodity, is greater in the case of grain and cotton than it is in the case of hides. In fact, the method of marketing hides which existed before future trading was inaugurated, and which has continued unchanged since, frequently involves hides passing direct from the packer, who may be regarded as the producer, to the tanner or consumer. The relation between the volume of business on the Hide Exchange and the total consumption of hides is, therefore, of much greater significance than a similar relationship would be in the case of grain or cotton. It will be seen from Table I (A) that the volume of business on the Exchange has fluctuated considerably. At the lowest point (1933) the number of contracts represented 35 per cent. of the total consumption of hides in the United States, while last year the proportion was nearly 65 per cent. Throughout the six and a half years, however, the volume of business has been such that it cannot have failed to influence the spot market.

The number of actual deliveries made against exchange contracts was the greatest in 1935, when 980 transferable notices were issued, representing about three-quarters of a million hides, or about $3\frac{1}{2}$ per cent. of the total consumption of hides in the United States in that year. Taken as a proportion of the total number of contracts made in 1935 futures, actual deliveries in 1935 represented 4.2 per cent. These figures show that while the volume of business on the Exchange has been appreciable, there has been very little interference with the general system of marketing hides by reason of deliveries against exchange contracts.

* It will be seen later that although future trading is allowed in the current and twelve succeeding calendar months, in practice it is concentrated in about four delivery months.

† A transferable notice is issued when a seller is ready to make delivery upon his contract. As its name implies, it can be passed from firm to firm in settlement of outstanding contracts, the last recipient taking delivery of the physical commodity.

Effect of Future Trading on Hide Prices.

It is frequently claimed by supporters of the system that future trading in any commodity tends to reduce the major fluctuations in spot prices. The process of producing leather from hides is a relatively long one, frequently extending to five or six months or even longer. During this period hide prices may fluctuate considerably, and the tanner may find when his leather is ready for sale that hide prices, and with them leather prices, have fallen substantially from the level at which he bought the hides at the beginning of the period, with the result that he has to accept a much lower price for his leather than he had anticipated. The magnitude of the fluctuations in the past has been such that frequently, in addition to wiping out the manufacturing profit, the tanner has suffered heavy losses. On the other hand, of course, there are times when the tanner finds that between buying his hides and selling the leather made from them, hide prices have advanced, and he is able to make an additional profit. There are few manufacturers, however, who would not prefer a period of relatively stable hide-prices with the prospect of making a reasonable manufacturing profit, rather than running the risk of unexpected gains and unexpected losses through fluctuating raw-material values.

The New York Hide Exchange has been operating for a sufficiently long period now for us to see whether there is any evidence that it has had any "damping" effect on hide price fluctuations. It is not sufficient to compare American hide price fluctuations before and after the introduction of future trading; * these must be considered in relation to fluctuations in prices of hides where there is no future trading. For this purpose I shall compare the fluctuations in prices of two of the most important classes of American hides, viz. Chicago No. 1 Packer Light Native Cows (the basic grade on the Exchange), which I shall refer to as Hide A, and Chicago No. 1 Heavy Packer Steers, which I shall refer to as Hide B, with the fluctuations in prices of the corresponding classes of English hides, viz. Manchester 1st Class Cows, 50-59 lbs. (Hide α), and Manchester 1st Class Ox, 60-69 lbs. (Hide β). It may be mentioned that the correlation between movements of American and English hide prices is not large. For example, over the period May 1925 to May 1929, i.e. the period of stable sterling-dollar exchange prior to the opening of the New York Hide Exchange, the correlation coefficient between

* It should be pointed out that there is no spot price quotation on the Hide Exchange similar to those on certain future Exchanges. The spot prices for American hides both before and after June 1929 are therefore obtained in the same manner from actual trading in hides.

the change in prices of A and α over a period of 20 weeks was 0.589, with a probable error of 0.030.

It has been pointed out that the intrinsic value of a unit weight of hide varies at different seasons of the year, and a rise of 1 cent or $\frac{1}{2}d.$ per lb. between two particular dates may represent the seasonal difference in quality, *i.e.* the tanner may be paying no more for his "pelt" or leather-producing substance at the second date than at first. Any comparison of hide-price fluctuations must, therefore, take into account the seasonal variation in condition. All quotations on the New York Hide Exchange refer to hides of July–August–September take-off, and there are fixed discounts for hides taken off in other months. These discounts have been modified twice since the opening of the Exchange, the figures for the second series being between those for the first and third series. The error introduced by taking one of the series rather than another for the purpose of this analysis is very small, and I have taken the second series, which is as follows:—

Month.	Discount, per cent.			
January	9
February }	12
March }	9
April	6
May	3
June	—
July }	—
August }	—
September }	2
October	4
November	6
December	6

Thus, in order to convert the spot price of American hides (per lb.) in any particular month to the equivalent price (per lb.) for hides of July–August–September take-off, the following additions must be made:—

Month.	Per cent.			
January	10
February }	13½
March }	10
April	6½
May	3
June	—
July }	—
August }	—
September }	2
October	4
November	6
December	6

An investigation of the seasonal variation of English hide prices over a period of 30 years has resulted in the following table :—

Seasonal Variation in English Hide Prices.

(Monthly average = 100.)

Month.	Index.
January	96
February	95
March	95
April	96
May	99
June	103
July	106
August	105
September	104
October	103
November	101
December	97

In order to convert the price of English hides (per lb.) in any particular month to the equivalent price (per lb.) for hides of July take-off, the following additions must be made :—

Month.	Percent.
January	10½
February }	11½
March }	
April	10½
May	7
June	3
July	—
August	1
September	2
October	3
November	5
December	9

Weekly prices of A, B, α and β have been taken over the 13 years 1923 to 1935. These prices have been adjusted using the above percentages to allow for seasonal variation, and the means, standard deviations and coefficients of variation (*i.e.* $\frac{S.D.}{Mean}$) for each year calculated. The results are shown in Table II.

The table covers six years (1923–28) prior to, and six years (1930–35) subsequent to the introduction of future trading. Comparing the coefficients of variation for A and α , during the period 1923–28 C.V. (A) averaged 11.7 per cent. and C.V. (α) 6.9 per cent., the former being in excess of the latter during four of the six years, while during the period 1930–35 C.V. (A) averaged 18.7 per cent. and C.V. (α) 9.5 per cent., the former being in excess of the latter each year. As far as weekly fluctuations within the year are concerned, it would appear, therefore, that prior to the introduction of future trading, fluctuations in the American Hide A were greater

than fluctuations in the English Hide α four times out of six, but since 1929 fluctuations in Hide A have always been greater than in Hide α , and the margin between the measures of fluctuations has actually increased. A comparison of C.V. (B) and C.V. (β) leads to a similar conclusion, the averages for C.V. (B) and C.V. (β) during the period 1923-28 being 11.7 per cent. and 7.8 per cent. respectively, and during the period 1930-35 16.8 per cent. and 9.2 per cent. respectively.

Taking the six years 1923-28 as a single period and the six years 1930-35 as a single period, we arrive at the figures for the means, standard deviations and coefficients of variation shown in Table III.

TABLE III.

Variation in American and English Hide Prices 1923-28 and 1930-35.

A.P. = Average Price. S.D. = Standard Deviation.
C.V. = Coefficient of variation.

	1923-28.			1930-35.		
	A.P.	S.D.	C.V.	A.P.	S.D.	C.V.
American Hides :	cents	per lb.	per cent.	cents	per lb.	per cent.
A	16.65	4.53	27.2	9.50	2.67	28.1
B	18.45	4.26	23.1	10.85	3.28	30.2
English Hides :	d. per lb.	per cent.	d. per lb.	per cent.		
α	7.89	1.34	17.0	4.88	0.83	17.0
β	8.66	1.27	14.7	5.66	1.12	19.8

It will be seen that there was a slight increase between 1923-28 and 1930-35 in C.V. (A), while C.V. (α) remained unchanged. Both C.V. (B) and C.V. (β) increased, the increase in the former being rather greater than in the latter.

In addition to the fluctuations about the mean, the range of variation of hide prices is of great importance to the leather manufacturer. Table IV shows for each of the years 1923-35 the mean range of variation of weekly values (highest to lowest) and the coefficient of range (*i.e.* $\frac{\text{Range}}{\text{Mean}}$).

A comparison of C.R. (A) and C.R. (α) and of C.R. (B) and C.R. (β) similar to that for the coefficients of variation indicates that the coefficients of range for American hide prices since 1929 have been consistently greater than for English hide prices, and the margin between the two has been, on the whole, greater than it was prior to 1929.

TABLE IV.
Range of Variation of American and English Hide Prices—1923-35.

A.P. = Average Price. R. = Range. C.R. = Coefficient of Range.

Year,	American Hides.				English Hides.			
	A.		R.		a.		β	
	A.P.	R.	C.R.	R.	A.P.	R.	A.P.	R.
	cents per lb.	per cent.	per lb.	per cent.	d per lb.	per cent.	d per lb.	per cent.
1923	13.68	7.25	53.0	17.40	7.42	1.25	8.41	2.00
1924	13.15	6.25	47.6	15.58	7.58	0.87	8.36	1.50
1925	15.40	2.50	16.2	16.83	7.41	1.37	8.18	1.87
1926	13.83	2.75	19.9	14.88	6.40	2.00	31.2	1.75
1927	20.00	10.50	52.5	20.80	8.25	3.37	8.86	3.50
1928	23.83	10.75	45.1	25.18	10.26	3.37	10.76	3.50
1929	16.43	5.50	33.4	17.75	7.36	2.62	7.94	2.25
1930	12.30	7.50	61.0	14.58	5.81	1.62	7.54	1.37
1931	8.98	5.50	61.3	9.58	4.60	1.25	5.68	2.00
1932	5.98	4.25	71.1	6.43	3.69	1.62	4.45	1.50
1933	9.40	8.75	88.4	10.20	4.75	2.37	5.24	2.87
1934	9.25	5.75	62.2	10.57	4.94	0.87	5.04	1.00
1935	10.58	4.00	37.8	13.70	5.45	1.62	6.03	1.62

We are thus led to the conclusion that there is no evidence that the introduction of future trading in America has had any damping effect on the fluctuations of spot prices—in fact, the evidence tends to point in the opposite direction. The increase in the margin between the C.V.'s and the C.R.'s since 1929 does not, however, appear sufficient to justify a dogmatic conclusion, especially when it is remembered that the period covered such economic disturbances as the suspension of the Gold Standard in the United Kingdom and the advent of the New Deal in America.

The Structure of Futures Prices.

Future trading is allowed by the Exchange rules in the current and twelve succeeding calendar months. During the first month the Exchange was open (June 1929) sales were made in futures for all possible delivery months. Before the Exchange had been operating for long, however, trading became confined to three or four delivery months, May, September and December being the most popular. After the expiry of the May 1931 future, trading in May futures practically ceased, and March and June futures became an active market. Since then trading has been regularly confined to the four futures March, June, September and December.

As might have been expected, the new market took some little time to adjust itself as far as the relationship between prices for the different delivery months was concerned. At the close of the first day's operations prices were as follows:—

Delivery Month.	Cents per lb.	
	Bid.	Asked.
1929		
August	16-82	—
September	17-02	17-07
October	17-02 Nom.	—
November	17-02 Nom.	—
December	17-10	—
1930		
January	17-10	—
February	17-05 Nom.	—
March	17-05 Nom.	—
April	17-10	—
May	17-00	—

The spot price of Light Native Cow Hides (the basic grade) at the time was 16½ cents per lb., equivalent to 16½ cents per lb. for hides of July–August–September take-off (the basis of futures quotations). By the end of the first week the spread between the price of near

and distant month futures was 1 cent, and on July 2nd, 1929, four weeks after the Exchange opened, the closing prices were as follows :—

Delivery Month.				Cents per lb.	
				Bid.	Asked.
19-9					
August	...	...	..	17-30 Nom.	—
September	...	...	..	17-70	—
October	...	...	...	18-00 Nom.	—
November	...	...	...	18-30 Nom.	—
December	...	...	...	18-70	18-75
1930					
January	...	...	...	18-60	18-90
February	...	...	...	18-70	—
March	...	...	...	18-90	—
April	...	...	...	19-00	—
May	...	...	...	19-30	19-35
June	...	...	...	19-50 Nom.	—

The general rule that distant month futures command a premium over near month futures has held throughout the six and a half years since then, but the spread between prices for different delivery months has varied considerably. As will be seen later in the paper, this question of "spread" is of very great importance in relation to hedging; I propose therefore to examine it in some detail.

It has been pointed out that since the middle of 1931 future trading has been confined almost entirely to four delivery months, March, June, September and December, *i.e.* on any particular date, say August 1st, there is active trading in futures contracts for delivery in the following September, December, March and June. Regarding September as the nearest active future, we can speak of the difference between the prices of the December and September futures as the three months' spread, while the difference between the March and September futures would be the six months' spread, and the difference between the June and September futures the nine months' spread. Table V shows for the first trading day of each month from July 1931 to December 1935, (i) the nearest active future and its price, (ii) the three months' spread and the average spread per month, (iii) the six months' spread and the average spread per month, and (iv) the nine months' spread and the average spread per month. As a particular future approaches maturity (*i.e.* as the delivery month gets near to and finally becomes the current month) trading activity in that particular future falls off, and eventually the price becomes mainly nominal. Thus at the beginning of September the September future can no longer be regarded as active

TABLE V.

Spread between Futures Prices on First Trading Day of each month. July 1931–December 1935.

(Price in cents per lb.)

Nearest Active Future.			Three Months' Spread.		Six Months' Spread.		Nine Months' Spread.	
Month.	Month.	Price.	Spread.	Average per Month.	Spread.	Average per Month.	Spread.	Average per Month.
1931								
July	Sept.	11-60	1-35	0-45	2-25	0-38	2-97	0-33
Aug.	"	10-60	1-35	0-45	2-25	0-38	3-10	0-34
Sept.	"	7-30	1-15	0-38	2-32	0-39	3-30	0-37
Sept.	Dec.	8-45	1-17	0-39	2-15	0-36	—	—
Oct.	"	5-90	0-85	0-28	1-75	0-29	2-55	0-28
Nov.	"	7-25	0-67	0-22	1-65	0-28	2-55	0-28
Dec.	"	6-75	0-33	0-11	1-15	0-19	1-87	0-21
Dec.	March	7-08	0-82	0-27	1-54	0-26	—	—
1932								
Jan.	March	6-60	0-66	0-22	1-30	0-22	1-90	0-21
Feb.	"	6-47	0-59	0-20	1-23	0-21	1-80	0-20
March	"	5-10	1-97	0-66	2-62	0-44	3-25	0-36
March	June	7-07	0-65	0-22	1-28	0-21	—	—
April	"	5-20	0-59	0-20	1-12	0-19	1-60	0-18
May	"	4-41	0-70	0-23	1-29	0-22	1-59	0-18
June	"	3-60	0-53	0-18	1-15	0-19	1-60	0-18
June	Sept.	4-13	0-62	0-21	1-07	0-18	—	—
July*	" (O.C.)	4-15	0-65	0-22	1-05	0-18	—	—
July	" (N.C.)	3-70	—	—	—	—	1-87	0-21
Aug.	" (O.C.)	5-00	0-82	0-27	1-45	0-24	—	—
Aug.	" (N.C.)	4-25	—	—	—	—	2-75	0-31
Sept.	" (O.C.)	6-00	1-30	0-43	1-90	0-32	—	—
Sept.	" (N.C.)	6-00	—	—	—	—	2-95	0-33
Sept.	Dec. (O.C.)	7-30	0-60	0-20	—	—	—	—
Sept.	" (N.C.)	7-20	—	—	1-75	0-29	—	—
Oct.	" (O.C.)	6-35	0-45	0-15	—	—	—	—
Oct.	" (N.C.)	6-40	—	—	1-50	0-25	2-00	0-22
Nov.	" (N.C.)	4-65	0-90	0-30	1-50	0-25	2-00	0-22
Dec.	" (N.C.)	4-15	0-75	0-25	1-30	0-22	1-75	0-19
Dec.	March	4-90	0-55	0-18	1-00	0-17	—	—
1933								
Jan.	March	5-69	0-46	0-15	0-96	0-16	1-41	0-16
Feb.	"	5-00	0-37	0-12	0-77	0-13	1-12	0-12
March	"	5-22	0-30	0-10	0-70	0-12	1-05	0-12
March	June	5-52	0-40	0-13	0-75	0-13	—	—
April	"	5-95	0-42	0-14	0-80	0-13	1-15	0-13
May	"	9-25	0-50	0-17	1-00	0-17	1-50	0-17
June	"	12-35	0-62	0-21	0-80	0-13	1-13	0-13
June	Sept.	12-97	0-18	0-06	0-51	0-09	—	—
July	"	12-75	0-18	0-06	0-40	0-07	0-65	0-07
Aug.	"	12-95	0-37	0-12	0-67	0-11	0-95	0-11
Sept.	"	12-50	0-03	0-01	0-22	0-04	0-45	0-05
Sept.	Dec.	12-53	0-19	0-06	0-42	0-07	—	—
Oct.	"	10-40	0-30	0-10	0-62	0-10	0-80	0-09
Nov.	"	8-70	0-85	0-28	1-22	0-20	1-50	0-17
Dec.	"	9-90	1-05	0-35	1-60	0-27	1-87	0-21
Dec.	March	10-95	0-55	0-18	0-82	0-14	—	—

TABLE V (continued).

Month.	Nearest Active Future.		Three Months' Spread.		Six Months' Spread.		Nine Months' Spread.	
	Month.	Price.	Spread.	Average per Month.	Spread.	Average per Month.	Spread.	Average per Month.
1934								
Jan. ...	March	10.50	0.53	0.18	0.90	0.15	1.10	0.12
Feb. ...	"	10.47	1.05	0.35	1.46	0.24	1.73	0.19
March ...	"	<i>8.45</i>	<i>1.80</i>	<i>0.60</i>	<i>2.25</i>	<i>0.38</i>	<i>2.80</i>	<i>0.31</i>
March ...	June	10.25	0.45	0.15	1.00	0.17	—	—
April ...	"	11.30	0.77	0.26	1.20	0.20	1.50	0.17
May ...	"	10.77	0.47	0.16	0.88	0.15	1.13	0.13
June ...	"	<i>7.75</i>	<i>0.37</i>	<i>0.12</i>	<i>0.67</i>	<i>0.11</i>	<i>1.15</i>	<i>0.13</i>
June * ...	Sept. (S.C.)	8.55	0.35	0.12	0.77	0.13	—	—
July ...	"	8.25	0.15	0.05	0.35	0.06	0.75	0.08
Aug. ...	"	6.57	0.43	0.14	0.73	0.12	1.01	0.11
Sept. ...	"	<i>7.30</i>	<i>0.25</i>	<i>0.08</i>	<i>0.58</i>	<i>0.10</i>	<i>0.85</i>	<i>0.09</i>
Sept. ...	Dec.	7.55	0.33	0.11	0.60	0.10	—	—
Oct. ...	"	7.53	0.25	0.08	0.50	0.08	0.82	0.09
Nov. ...	"	7.73	0.37	0.12	0.64	0.11	0.92	0.10
Dec. ...	"	<i>8.20</i>	<i>0.35</i>	<i>0.12</i>	<i>0.70</i>	<i>0.12</i>	<i>1.01</i>	<i>0.11</i>
Dec. ...	March	8.55	0.35	0.12	0.66	0.11	—	—
1935								
Jan. ...	March	9.56	0.34	0.11	0.69	0.12	1.00	0.11
Feb. ...	"	9.31	0.28	0.09	0.64	0.11	0.91	0.10
March ...	"	<i>9.25</i>	<i>0.35</i>	<i>0.12</i>	<i>0.67</i>	<i>0.11</i>	<i>1.00</i>	<i>0.11</i>
March ...	June	9.60	0.32	0.11	0.65	0.11	—	—
April ...	"	9.05	0.31	0.10	0.62	0.10	0.95	0.11
May ...	"	10.00	0.34	0.11	0.66	0.11	0.98	0.11
June ...	"	<i>9.50</i>	<i>0.30</i>	<i>0.10</i>	<i>0.65</i>	<i>0.11</i>	<i>0.97</i>	<i>0.11</i>
June ...	Sept.	9.80	0.35	0.12	0.67	0.11	—	—
July ...	"	10.55	0.32	0.11	0.65	0.11	0.95	0.11
Aug. ...	"	10.04	0.33	0.11	0.66	0.11	0.98	0.11
Sept. ...	"	<i>10.71</i>	<i>0.29</i>	<i>0.10</i>	<i>0.64</i>	<i>0.11</i>	<i>0.91</i>	<i>0.10</i>
Sept. ...	Dec.	11.00	0.35	0.12	0.62	0.10	—	—
Oct. ...	"	11.23	0.34	0.11	0.64	0.11	0.94	0.10
Nov. ...	"	11.81	0.33	0.11	0.69	0.11	0.99	0.11
Dec. ...	"	<i>11.04</i>	<i>0.35</i>	<i>0.12</i>	<i>0.68</i>	<i>0.11</i>	<i>1.00</i>	<i>0.11</i>
Dec. ...	March	11.39	0.33	0.11	0.65	0.11	—	—

* The contract was modified in 1932 and again in 1934. In the former year (O.C.) refers to the so-called Old Contract and (N.C.) to the New Contract, while in 1934 (S.C.) refers to the so-called Standard Contract then introduced.

from a trading point of view, and in the table I have regarded the nearest active month in this case as December, and so on. The figures which would be obtained by continuing at the beginning of September to regard September as the nearest active month (and similarly for December, March and June) are shown for purposes of comparison in italics.

It will be seen that there has been a definite downward trend in the spread taken over 3, 6 or 9 months, and during 1935 the spread

per month has been remarkably consistent, averaging 0.11 cent per lb., or approximately half of what it was in 1932, and only about a third of what it was in the second half of 1931. The method of taking only a single day in each month is, of course, open to the objection that there may have been exceptional activity on that day in one particular future which has temporarily thrown out of line the spread between prices for different delivery months. An examination of the prices for futures on days close to those taken in Table V, which show apparently exceptionally high or low spreads, indicates that there are very few values which would be appreciably modified for this reason.

At a time of rapidly changing prices it is only to be expected that market sentiment regarding the future will affect the spread in futures prices. Following the steep rise in prices during the spring of 1933, for example, fears began to be felt as to whether the new level established by June was really justified, and although prices did not actually begin to fall until September, there was a marked contraction in the average futures spread during July, August and September.

The cost of storing hides in a licensed warehouse in New York in 1929 was 0.12 cent per lb. per month. Since then the cost has fallen to 0.09 cent per lb. per month. If the spread between, say, March and September futures is sufficiently large, it may pay an operator on the Exchange to buy March futures and sell September, take delivery of his hides in March, store them until September, and finally deliver them against his September contract. Other costs besides storage which must be taken into consideration are interest, insurance, certification charges and delivery costs. Of these the first is the most important. The average rate of exchange * and the average price of Hide A (unadjusted) in each year since 1931 are given below.

Year.					Average Rate of Interest, per cent.	Average Price of Hide A, cents per lb.
1931	...	...	...	...	4.22	8.5
1932	...	...	...	...	4.49	5.7
1933	...	...	...	...	4.02	9.5
1934	...	...	...	...	3.33	8.7
1935	...	...	...	...	2.71	10.1

* Weighted average of rates charged to customers by banks in New York City taken from the Federal Reserve Bulletin. If the corresponding rates for eight other northern and eastern cities had been taken the average interest charge per month during each of the five years would have been: 1931, 0.033; 1932, 0.024; 1933, 0.038; 1934, 0.031; and 1935, 0.032 cent per lb.

The average interest charge per month during each of the five years has therefore been as follows :—

Year.					Average Interest Charge per Month, cents per lb.
1931	...	...	...	...	0.030
1932	...	...	...	...	0.021
1933	...	...	...	...	0.032
1934	...	...	...	...	0.024
1935	...	...	...	...	0.023

During the five years 1931 to 1935 the total storage plus interest charge has varied only between 0.15 and 0.11 cents per lb. per month. In the earlier part of the period the average spread per month was well in excess of this charge, but in 1935—the year in which the coefficient of variation of Hide A (the basic grade) was the lowest since future trading was introduced—the average spread per month was almost constant and approximately equal to the storage plus interest charge.

Hedging.

Supporters of the system of future trading invariably attach the greatest importance to the opportunity afforded by a futures Exchange for hedging as a means of price insurance. Hedging is the practice of buying or selling futures to offset an equal and opposite position in the cash market, it being the intention of the operator to close his position in the futures market at a later date, when he closes his position in the cash market. For example, if a merchant buys cotton in October, some of this may be sold again almost immediately, but some may be held in store for several months. He may find, say, in December that the price of cotton has declined from the October level and that his estimated profit has been considerably reduced, or that he has actually made a loss. If he had decided to hedge his transaction, he would have sold futures on the Cotton Exchange in October for a quantity equivalent to his purchase of raw cotton, and as he sold the cotton, bought back his futures on the Exchange. If the price of raw cotton had fallen, his loss on the physical transaction would be offset by a profit on the futures transaction. If, on the other hand, the price of raw cotton had risen, he would sustain a loss on his futures, but this would be offset by a profit (over and above his normal merchandising profit) on the actual cotton. A manufacturer of motor tyres may enter into a contract for the delivery of tyres six months ahead, although he may not have the crude rubber in stock from which the tyres are to be made. In order to protect himself he buys futures on the Rubber Exchange for an amount equivalent to the quantity of

crude rubber he requires, and later, when he purchases the rubber, he sells out his futures. At another time the same manufacturer may purchase a quantity of crude rubber in excess of the requirements for his forward contracts for tyres. He can hedge such quantity by selling futures on the Exchange, and when he makes a contract or sells the tyres, he buys back his futures. In either case, the loss or profit on the actual transaction is balanced by the profit or loss on the futures transaction. *Such is the theory of hedging.* In practice, however, it is very rarely that the profit on one transaction exactly balances the loss on the other transaction. This would only be the case if futures prices and spot prices moved in parallel. In some cases the profit on one transaction only partially covers the loss on the second, while in other cases the profit on one is actually greater than the loss on the other, and the operator makes an additional unexpected profit.

I now propose to compare the movements in prices of hide futures with the movements in spot prices, in order to see to what extent hedging on the New York Hide Exchange has provided insurance against price fluctuations. The process of tanning hides is a relatively long one, extending in some cases up to six months or even more. For this reason a manufacturers' hedge would normally cover a period of several months, and I have, therefore, taken periods of 15, 20 and 25 weeks over which to measure price movements.

Considering the 15-week period, I have taken the spot price of Hide A (the basic grade), adjusted to July-August-September conditions, on Friday of each week since the opening of the Exchange, and calculated the change in this price over the next 15 weeks. On each Friday I have also taken the price of futures for the next active month following the expiry of 15 weeks, and calculated the change in price of this future over 15 weeks. For example, on March 15th, 1935, the spot price of Hide A was $7\frac{3}{4}$ cents per lb., equivalent to 8.8 cents per lb. for a July-August-September hide. Fifteen weeks later, *i.e.* on June 28th, 1935, the spot price was $9\frac{3}{4}$ cents per lb., or 10.0 cents per lb. when adjusted for condition. Over the 15 weeks there had thus been an increase of 1.2 cents per lb. in the adjusted spot price. On June 28th the next active future would be September. The price of September futures on March 15th was 9.24 cents per lb., and on June 28th, 10.63 cents per lb., an increase of 1.39 cents per lb. When these figures had been set out for each week from the beginning of June 1929, it was found that the $6\frac{1}{2}$ years could be divided up into ten distinct periods. For each of the 76 weeks from June 7th, 1929, to November 14th, 1930, the adjusted spot price showed a decline during the following 15

weeks.* The average adjusted spot price during this period was 14.23 cents per lb., and the average decline over 15 weeks was 1.75 cents per lb. The average decline in the price of futures over 15 weeks for the same period was 2.78 cents per lb. For each of the next 25 weeks from November 21st, 1930, to May 8th, 1931, the adjusted spot price showed an increase during the following 15 weeks. The average adjusted spot price during this period was 8.96 cents per lb., and the average advance over 15 weeks was 1.34 cents per lb. Futures prices, however, got out of line with spot prices during the period, and there was an average decline over 15 weeks of 0.17 cent per lb. The results for the ten periods are shown in Table VI.

It will be seen that movements in futures over 15 weeks have differed very considerably from movements in spot prices over the same period. In each of the five periods when the spot market was falling the average fall in futures was greater than the average fall in spot prices. In the first period spot prices fell on the average by 12.3 per cent., while futures fell by 19.5 per cent. In the second period the margin was 12.6 per cent. of the average adjusted spot price. In the following two periods of a falling market the margin narrowed, and during the 17 weeks ending 22nd September, 1933, the difference between the average declines of spot and futures was only 1.7 per cent. of the average spot price. The margin increased, however, in the final period of falling prices. In the first of the five periods when the spot market was rising there was actually a slight decline in the average movement of futures. In each of the remaining four periods futures showed an advance, but the average rise was appreciably less than that in spot prices, the margin between the two being smallest in the last period of all.

This margin between the advance or decline in spot prices and the advance or decline in futures may be divided into two parts, the first (*a*) being due to the spread of futures prices, and the second (*b*) to the convergence or divergence of the spot price and the general futures price system.†

* With the exception of two weeks in November 1929 when there were increases of 0.4 and 0.7 cent per lb. These, however, are not of sufficient significance to justify splitting up the period. Similar exceptions do not occur in any of the other periods.

† To the mathematician the following conception may be of interest: The "general futures price system," i.e. the structure of four active futures (March, June, September and December) may be regarded as four points P_1, P_2, P_3, P_4 in a straight line L of varying length parallel to the price axis in a two-dimensional "price-time" field. The points P_1, P_2, P_3, P_4 move downwards in the line L as L itself travels from left to right along the time axis. This movement of P_1, P_2, P_3, P_4 in L is due to the futures approaching maturity, and the consequent reduction in spread. The general futures price system (or the line L) itself moves in the price-time field, and so does the spot price S . The (*a*) and (*b*) referred to above are, therefore, the movement of P in L and the convergence or divergence of S and L .

TABLE VI.

Change in Spot and Futures Prices Over 15 Weeks.

The table shows for each of the ten periods the average change over 15 weeks in spot and futures prices. For example, during the 17 weeks June 2nd to September 22nd, 1933, the average spot price adjusted for condition was 13-03 cents per lb. Comparing the adjusted spot price on each Friday during that period with the price 15 weeks later, there was in each case a decline, the average of the 17 declines each measured over 15 weeks being 2-55 cents per lb. The corresponding average decline in futures was 2-78 cents per lb.

Spot Market.	From	To	No. of Weeks.	Average Adjusted Price (p), cents per lb.	Average Advance over 15 Weeks in				Average Decline over 15 Weeks in			
					Spot.		Futures.		Spot.		Futures.	
					Cents per lb.	Per cent. of p.	Cents per lb.	Per cent. of p.	Cents per lb.	Per cent. of p.	Cents per lb.	Per cent. of p.
Falling	...	14.xi.30	76	14-23	—	—	—	—	1-75	12-3	2-78	19-5
Rising	...	8.v.31	25	8-06	1 34	15-0	—	—	—	—	0-17	1-9
Falling	...	8.iv.32	48	8-36	—	—	—	—	1-94	23-2	2-99	35-8
Rising	...	5.viii.32	17	4-63	2-15	46-5	0-75	16-2	—	—	—	—
Falling	...	18.xi.32	15	6-95	—	—	—	—	1-46	21-0	1-75	25-2
Rising	...	26.v.33	27	6-79	4-27	62-9	3-64	53-6	—	—	—	—
Falling	...	22.ix.33	17	13-03	—	—	—	—	2-55	19-6	2-78	21-3
Rising	...	19.i.34	17	10-36	0-96	9-3	0-08	0-8	—	—	—	—
Falling	...	20.vii.34	26	10-52	—	—	—	—	2-40	22-8	2-97	28-2
Rising	...	13.ix.35	60	9-10	1-19	13-1	0-66	7-3	—	—	—	—

It has been shown that the spread of futures prices varies appreciably, but is not normally less than the storage plus interest charge for the period. During the $6\frac{1}{2}$ years since future trading was introduced the storage plus interest charge for 15 weeks averaged 0.49 cent per lb., and this may be regarded as the *expected* value of (*a*), but (*a*) may, and frequently has, exceeded this, or may occasionally fall short of it. The second part (*b*) is unpredictable.

Turning to the definite problem of hedging, it will be realised that owing to the factor of spread in futures prices the operator who employs a selling hedge (*i.e.* sells futures at the beginning of the period and buys an equivalent quantity at the end of the period) stands to gain more than the operator who employs a buying hedge. If (*a*) has the *expected* value and (*b*) is zero, the man who uses the selling hedge will obtain his price insurance plus an extra profit equal to (*a*), while the man who uses the buying hedge will make a loss of (*a*). Out of the ten periods shown in Table VI, the margin between the average advance or decline in spot prices and the average advance or decline in futures exceeded the *expected* value of (*a*) in eight periods. The margin had the smallest average value in the fourth period of a falling market. In this period of 17 weeks the tanner who bought hides each week from June 2nd to September 22nd, 1933, and sold futures on the Exchange, buying an equivalent quantity of futures when he sold the finished leather 15 weeks later, would have obtained complete price insurance and made an extra profit of 1.7 per cent. The price of his actual hides declined by 2.55 cents per lb., or 19.6 per cent., while he made an average profit of 2.78 cents per lb., or 21.3 per cent. (of the average spot price) on his futures (ignoring the question of commission). On the other hand, the manufacturer who thought that the market which had been rising for the previous 27 weeks would rise still farther, and wishing to secure supplies of hides 15 weeks later without paying an increased price, bought futures each week from June 2nd to September 22nd, 1933, selling an equivalent quantity at the end of the 15 weeks, would have found that on the average he had to pay 2.55 cents per lb. less for his actual hides than he had calculated, but he would have made a loss of 2.78 cents per lb. on his futures. Thus, during the 17 weeks ending 22nd September, 1933, while not providing perfect price insurance, the Exchange could be regarded as giving a satisfactory measure of cover during the period.

Turning to some of the other periods, however, it will be seen from Table VI that instead of obtaining price insurance, the operator either made an appreciable net gain or loss according to the manner in which the hedge was employed. In the second period of rising prices, for example, spot prices advanced on the average by 46.5 per

cent., while futures advanced by only 16.2 per cent. An operator employing a buying hedge, therefore, would obtain cover for little more than one-third of the advance in price of actual hides, while the operator employing a selling hedge would find that the advance in spot prices, after covering his loss in futures, left him with a profit equal to 30 per cent. of the average spot price. The insurance provided was therefore imperfect, since when speaking of price insurance, a system which provides a certain operator with a 20 per cent. additional unexpected profit is considered imperfect from the theoretical standpoint, just as a system which provides only 80 per cent. cover.

Table VII shows the average movements in spot and futures prices over 20 weeks. As in the case of Table VI, the 6½ years are divided into ten clearly defined periods (not, of course, identical with the periods in Table VI). With the exception of the fourth period of rising prices, the margins between the average advances or declines of spot and futures over 20 weeks were greater than over 15 weeks, indicating a smaller measure of price insurance in these periods.

The results obtained by taking a 25-week period are shown in Table VIII. In each of the ten periods the margins between the average advances or declines of spot and futures over 25 weeks were greater in cents per lb. than over 20 weeks, although in the first period of falling prices and the second period of rising prices the margins in Table VIII expressed as a percentage of the average spot prices were slightly less than the corresponding percentages in Table VII. On the whole, however, the measure of price insurance afforded over 25 weeks was smaller than over 20 weeks.

In applying the results of Tables VI, VII and VIII to the problem of hedging, it has been assumed that the hedging was automatic, *i.e.* that futures were bought on a particular day at the market price and sold exactly 15, 20 or 25 weeks later at the market price. No doubt on occasion an astute operator could have improved to some extent the futures transaction by careful study of the market, *e.g.* by delaying for a day or so his buying or selling if he thought that the market had been unduly pushed up or depressed or by switching his futures from one month to another. Such action, however, would only reduce the margins calculated by a very small amount.

A study of the evidence afforded by Tables VI, VII, and VIII leads to the definite conclusion that hedging on the Hide Exchange has proved ineffective as a means of price insurance. Supporters of the system of future trading maintain that hedging enables the importer merchant or manufacturer to transfer the risk of price fluctuations to the professional speculator. The evidence shows

TABLE VII.
Change in Spot and Futures Prices Over 20 Weeks.

The table shows for each of the ten periods the average change over 20 weeks in spot and futures prices. For example, during the 30 weeks October 21st, 1932, to May 12th, 1933, the average spot price adjusted for condition was 6.36 cents per lb. Comparing the adjusted spot price on each Friday during that period with the price 20 weeks later, there was in each case an advance, the average of the 30 advances each measured over 20 weeks being 4.76 cents per lb. The corresponding average advance in futures was 3.98 cents per lb.

Spot Market.	From	To	No. of Weeks.	Average Adjusted Price (p), cents per lb.	Average Advance over 20 Weeks in				Average Decline over 20 Weeks in			
					Spot.		Futures.		Spot.		Futures.	
					Cents per lb.	Per cent of p.	Cents per lb.	Per cent of p.	Cents per lb.	Per cent of p.	Cents per lb.	Per cent of p.
Falling	...	7.vi.29	80	13.99	—	—	—	—	2.04	14.6	3.25	23.2
Rising	...	19.xii.30	16	8.84	1.72	19.5	—	—	—	—	0.36	4.1
Falling	...	10.iv.31	50	8.56	—	—	—	—	2.18	25.5	3.83	44.8
Rising	...	25.iii.32	18	4.78	2.01	42.1	0.37	7.7	—	—	—	—
Falling	...	29.vii.32	12	7.08	—	—	—	—	1.72	24.3	2.16	30.5
Rising	...	21.x.32	30	6.36	4.76	74.8	3.98	62.6	—	—	—	—
Falling	...	19.v.33	19	12.86	—	—	—	—	2.33	18.1	2.86	22.3
Rising	...	29.ix.33	13	10.23	1.04	10.2	0.18	1.8	—	—	—	—
Falling	...	29.xii.33	28	10.75	—	—	—	—	2.73	25.4	3.44	32.0
Rising	...	13.vii.34	57	8.96	1.49	16.6	0.83	9.3	—	—	—	—

TABLE VIII.

Change in Spot and Futures Prices Over 25 Weeks.

The table shows for each of the ten periods the average change over 25 weeks in spot and futures prices. For example, during the 22 weeks March 4th. to July 29th, 1932, the average spot price adjusted for condition was 5.09 cents per lb. Comparing the adjusted spot price on each Friday during that period with the price 25 weeks later there was in each case an advance, the average of the 22 advances each measured over 25 weeks being 1.34 cents per lb. The corresponding change in future prices over the period was an average decline of 0.32 cents per lb.

Spot Market.	From	To	No. of Weeks.	Average Adjusted Price (p), cents per lb.	Average Advance over 25 Weeks in				Average Decline over 25 Weeks in			
					Spot.		Futures.		Spot.		Futures.	
					(cents per lb.,	Per cent. of p.	Cents per lb.,	Per cent. of p.	Cents per lb.,	Per cent. of p.	(cents per lb.,	Per cent. of p.
Falling	7.vi.29	5.xi.30	79	14.05	—	—	—	—	2.47	17.6	3.77	26.8
Rising	12.xii.30	27.ii.31	12	8.27	2.90	35.0	0.25	3.0	—	—	—	—
Falling	6.iii.31	26.ii.32	52	8.83	—	—	—	—	2.45	27.8	4.58	51.9
Rising	4.iii.32	29.vii.32	22	5.09	1.34	26.3	—	—	—	—	0.32	6.3
Falling	5.viii.32	14.x.32	11	7.22	—	—	—	—	1.29	17.9	1.96	27.1
Rising	21.x.32	28.iv.33	28	6.07	5.67	93.4	4.64	76.4	—	—	—	—
Falling	5.v.33	29.ix.33	22	12.55	—	—	—	—	1.80	14.3	2.42	19.3
Rising	6.x.33	17.xi.33	7	9.61	2.10	21.8	0.81	8.4	—	—	—	—
Falling	24.xi.33	29.vi.34	32	10.82	—	—	—	—	2.70	25.0	3.69	34.1
Rising	6.vii.34	5.vii.35	53	8.87	1.71	19.3	0.96	10.8	—	—	—	—

that during the 6½ years since future trading was inaugurated hedging on the Hide Exchange has involved a very considerable element of speculation, and it cannot be said, so far, that the Exchange has achieved that which, according to its founders, was one of its main objectives.

An Alternative Method of Price Insurance.

The primary object of price insurance is the removal of risk. Over a long period of time a firm pursuing the same line of business with a reasonably steady turnover, whether merchanting or manufacturing, may find that the losses which it has suffered and the extra profits which it has made on account of price fluctuations have approximately balanced, but the same firm would have preferred to have been insured against the losses during times of declining prices, even if it had meant foregoing the extra profits in times of rising prices. The theory of hedging on a futures Exchange as a means of price insurance implies that the risks are passed on to the professional speculators.* The latter operate on the Exchange solely with the object of making a profit out of price fluctuations. Those who fail to make a profit soon disappear, and it may be assumed that the professional speculators as a body take more out of the Exchange than they put into it. The question naturally follows: Is it not possible to find some method of price insurance free from speculative interests? The suggestion has been put forward from time to time that price insurance might be treated in a similar manner to life insurance.

The Canadian Commission to enquire into Trading in Grain Futures, under the chairmanship of Sir Josiah Stamp, stated in its Report:—

“ More than once the suggestion was made to witnesses that possibly an element of certainty might be introduced into the field of insurance against price fluctuation by basing the risk upon actuarial probabilities rather than upon speculative manœuvres. The question was put as to whether there could not be a great international insurance company, which, in return for the payment of a small individual premium, would cover all risks. Could such a scheme, started at the right time, that is, in a period of relative price steadiness, not attain, with a sufficient accumulation of premiums, a sound position? Would it be more impracticable than explosion insurance

* On the older futures Exchanges participation by the general public is an important factor, but during the greater part of the period in which the New York Hide Exchange has been operating there has been very little business of this nature.

where, likewise, the risks cannot be spread in any one year but only over a long period of time?"

The Report goes on to state that the Commission found little encouragement for, or even interest in, any such scheme. The chief objection advanced by witnesses appears to have been that the premiums required "would be too high." It appears probable that the people who have expressed such an opinion approach the subject in the wrong manner. There is an essential difference between price insurance and life, fire, burglary and other insurances. No person who insures his house against fire at a premium of 1s. 6d. per cent. expects that over a long period of time the amount he receives in respect of claims will, even approximately, equal the amount he has paid in premiums. If he never makes a claim against the company, he does not complain that the premiums were too high because he has received nothing in return, but mentally offsets his satisfaction at not experiencing a fire against the premiums he has paid. Again, few people who take out a life assurance policy die at that age at which the accumulated value of the premiums paid equals the sum assured. In the case of a system of price insurance, the expectation of any particular firm would be that over a considerable period of time the total value of the net premiums* paid would be approximately equal to the total value of the claims paid, *but* during that period the firm would have the benefit of freedom from anxiety regarding price fluctuations, and would thus be able to work on a smaller capital than the firm which assumed the risk itself. The idea appears to be of sufficient interest to justify an examination of the data available regarding hide-price fluctuations in the past, to see whether it is possible to draw up a scale of premiums to insure against (a) a rise in price and (b) a fall in price.

For this purpose I have taken the data relating to five classes of English hides over the 14 years 1921-34. The classes are:—

(i) Ox hides, 1st class	...	...	...	70-79 lb.
(ii) " " " "	...	...	...	60-69 "
(iii) " " " "	...	...	...	50-59 "
(iv) Cow hides "	...	...	...	60-69 "
(v) " " " "	...	...	...	50-59 "

the prices being those in the Manchester market (which may be regarded as representative of English hide prices in general). Price quotations are in eighths-of-a-penny per lb. and, to facilitate working, the unit of price has been taken as $\frac{1}{8}$ d. In the first place, the

* The actual premium paid would be the net premium to cover the risk plus a loading for administration expenses. For the purposes of this paper I shall ignore the loading in the same way that I have ignored the commission payable to the broker on buying or selling futures.

actual prices have been adjusted for seasonal condition by the use of the table on page 305. Any scale of premiums which might be obtained can relate, of course, only to the variation of price over a certain period, and for the purpose of my investigation I have taken a period of 20 weeks. I have, therefore, calculated the change (d) in adjusted prices (p) over 20 weeks. The next step is to relate the change in price over the period to the price at the beginning of the period. Owing to the wide range of prices (p varied from 22 eighths-of-a-penny to 98 eighths-of-a-penny per lb.) and change in prices (d varied from a decline of 28 eighths-of-a-penny to an advance of 32 eighths-of-a-penny per lb.) it was necessary to adopt a grouping. In order to preserve a whole number (of eighths) as the central value of each group, I adopted groups of 3 (eighths). Thus the scale of prices ran from (22, 23, 24) to (97, 98, 99), while the scale of change in price over 20 weeks ran from (—28, —27, —26) through (—1, 0, 1) up to (32, 33, 34). Five tables were thus drawn up, one for each class of hides, each containing 730 observations (the number of weeks in the period 1921–34). It would be possible from these tables to draw up a scale of premiums relating to each class of hides, but it is obviously desirable to avoid separate calculations for each class. At the same time, the tables show that at any particular price, say, 65 eighths-of-a-penny per lb. (actually the group 64, 65, 66), the premium required to insure against a decline in price of Hide (i) is different from that required in the case of Hide (v), owing to the fact that the average price of the former rules higher than that of the latter. The obvious solution appears to be to take one class of hide as a standard, adjust the tables for the other classes so that the average values of the p 's coincide, calculate the scale of premiums on the aggregate table, and then relate the scale to the appropriate prices for each class of hides.

The average values of the p 's (to the nearest eighth-of-a-penny) are as follows:—

p_1	...	...	...	...	65 eighths
p_2	...	...	...	...	60 „
p_3	...	...	...	...	55 „
p_4	...	...	...	...	53 „
p_5	...	...	...	...	52 „

Taking Hide (ii) as the standard, we adjust the other four tables so that the class interval (64, 65, 66) for Hide (i), the class interval (55, 56, 57) for Hide (iii), and the class interval (52, 53, 54) for Hides (iv) and (v) coincide with $p = (58, 59, 60)$ for Hide (ii). We thus obtain the aggregate table for the change in adjusted hide prices over 20 weeks based on the standard hide (ii)—Table IX.

TABLE IX.
Aggregate Table showing Change in Adjusted Price of English Hides over 20 Weeks, for the 14 Years 1921-34.
 Data for 5 classes of hides standardized to basis of Hide (ii).
 (Prices in eighths-of-a-penny per lb.)

Adjusted Price at Beginning of Period (Standardized).	Change in Adjusted Price in 20 Weeks.																				Total	
	-28 -27 -26	-25 -24 -23	-22 -21 -20	-19 -18 -17	-16 -15 -14	-13 -12 -11	-10 -9 -8	-7 -6 -5	-4 -3 -2	-1 0 1	2 3 4	5 6 7	8 9 10	11 12 13	14 15 16	17 18 19	20 21 22	23 24 25	26 27 28	29 30 31		32 33 34
100, 101, 102		5		3		1	4		2												9	
97, 98, 99			2	5		7	11	5	3												20	
94, 95, 96			1	1	2	4	2	7	9	1	2	5	1								28	
91, 92, 93					10	13	2	2	5	3	6	3	1								27	
88, 89, 90					3	4	7	7	3												47	
85, 86, 87		3	2	3	6	5	7	3	3	3		10	10	3							35	
82, 83, 84					3	6	6	1	2	2		1	2	2	3	8					64	
79, 80, 81		2	3	4	29	13	11	9	1	1		4	2	1	1	2					43	
76, 77, 78				9	16	22	20	10	12		1					2					78	
73, 74, 75					7	24	48	54	31	20	12	4	2			2						
70, 71, 72					8	16	47	40	63	46	31	26	8	5	13	3	2	4	4		113	
67, 68, 69					7	8	12	39	40	54	110	94	46	26	12	6	2	6	2		218	
64, 65, 66					13	12	12	39	40	54	110	94	46	26	12	6	2	6	2		318	
61, 62, 63		2	2	3	4	13	6	25	43	49	98	65	47	17	10	5	2	2	3		474	
58, 59, 60		3	3	3	3	6	9	32	39	42	48	63	44	13	6	1	1				390	
55, 56, 57		1	1	1	1	7	7	11	15	21	16	26	29	38	9	2	3				316	
52, 53, 54				2	5	13	18	12	8	11	18	16	14	10	6	2	2	1			192	
49, 50, 51				2	2	5	24	42	9	10	5	15	16	4		2	1	1			138	
46, 47, 48				3	6	9	14	29	44	29	15	2			3	4	1				139	
43, 44, 45					1	7	9	35	61	47	30	14	1		2	5					157	
40, 41, 42							15	14	43	50	15	25	4	2			1				214	
37, 38, 39						7	15	14	33	35	36	21	11	5	4		1				171	
34, 35, 36							14	22	33	35	36	21	11	5	4		1				194	
31, 32, 33								1	25	31	21	12	7	14	17	13					151	
28, 29, 30									6	12	20	12	11	4	2	11	1	10	2		91	
												9	12	2							23	
Total	1	5	25	52	131	204	324	401	516	519	479	382	259	100	86	67	32	33	19	7	8	3,650
Total																						3,650

From Table IX it is possible to calculate the crude net premiums required for each value of p (strictly each class interval) to insure against (a) a rise and (b) a fall in price over the next 20 weeks. For example, taking the class interval (70, 71, 72), if we assume that each week when the adjusted hide price fell within this interval firm X paid a net premium of R (eighths-of-a-penny per lb.) to insure against a rise in price over the next 20 weeks, the total amount paid in premiums would be 218 R . Whenever the price rose over the next 20 weeks our hypothetical insurance company would make a payment equal to the rise in price, the total payments over the 34 weeks when this happened being 435. Equating premiums and claims $R = 2.0$. Similarly, if firm Y paid a net premium of F (eighths-of-a-penny per lb.) to insure against a fall in price over the next 20 weeks, we can calculate that $F = 5.7$.

TABLE X.

Net Premiums to Insure against a Rise or Fall in the Price of English Hides over 20 Weeks.

Central Value of p (in Eighths-of-a-penny per lb.) for Hide:				Premium (in Eighths-of-a-penny per lb.) to Insure Against α	
(i).	(ii).	(iii).	(iv) and (v).	Rise in Price.	Fall in Price.
98	92	89	86	1.1	11.8
95	89	86	83	1.3	10.9
92	86	83	80	1.5	10.0
89	83	80	77	1.8	9.2
86	80	77	74	2.0	8.3
83	77	74	71	2.2	7.5
80	74	71	68	2.4	6.6
77	71	68	65	2.6	5.9
74	68	65	62	2.8	5.3
71	65	62	59	3.1	4.8
68	62	59	56	3.3	4.3
65	59	56	53	3.6	3.9
62	56	53	50	4.0	3.6
59	53	50	47	4.4	3.2
56	50	47	44	4.8	2.9
53	47	44	41	5.2	2.6
50	44	41	38	5.7	2.3
47	41	38	35	6.2	2.0
44	38	35	32	7.0	1.8
41	35	32	29	7.8	1.6
38	32	29	26	8.8	1.4

It is obvious that the crude net premiums calculated for 25 class intervals from a table containing only 3,650 observations will contain anomalies. For example, at a time of rising prices there may be few values of p within a certain class interval C_r , compared with C_{r-1} and C_{r+1} . When prices are falling, however, the number

of values of p in C_r may be considerably greater than in C_{r-1} and C_{r+1} , and the crude net premiums for the three intervals will show an exceptionally low rate to insure against a rise in price, and an exceptionally high rate to insure against a fall in price for the interval C_r as compared with the premiums for C_{r-1} and C_{r+1} . I have, therefore, graduated the crude net premiums, and the results are shown in Table X. In this table I have referred the premiums for Hides (i), (iii), (iv) and (v) to the original values of p , the central value of the class intervals being shown.

Supposing the price of Hide (iii) adjusted for condition is $8\frac{1}{2}d.$ or 68 eighths-of-a-penny per lb., then the net premium required to insure against a rise in price is 2.6 eighths-of-a-penny per lb., or 3.8 per cent., while the net premium required to insure against a fall in price is 5.9 eighths-of-a-penny per lb., or 8.7 per cent. In the case of a claim, the full amount of the rise or fall would be paid.

Some firms might be interested in a scheme whereby they themselves assumed an initial risk of a certain amount, but were insured against a change in price over and above that amount. For example, a tanner might be interested in insuring against a fall in price in excess of $\frac{1}{2}d.$ per lb. or $1d.$ per lb., the claim (if any) being the amount by which the price fell after the first $\frac{1}{2}d.$ or $1d.$ per lb. respectively. The premiums for such an insurance would, of course, be considerably less than those in Table X. In Table XI, I show the premiums for insuring against (a) a rise and (b) a fall in price of $1d.$ per lb. or more (*i.e.* eliminating claims in respect of changes in price corresponding to the 3 and 6 groupings).

Taking the same example as before, *i.e.* supposing the price of Hide (iii) adjusted for condition is $8\frac{1}{2}d.$ or 68 eighths-of-a-penny per lb., then the net premium required to insure against a rise of price in excess of $7/8d.$ per lb. is 1.0 eighths-of-a-penny per lb. or 1.5 per cent., while the net premium required to insure against a fall in price in excess of $7/8d.$ per lb. is 2.4 eighths-of-a-penny per lb. or 3.5 per cent. In the case of a claim the excess of the rise or fall over $7/8d.$ per lb. would be paid.

The premiums in Tables X and XI are calculated on the experience of the 14 years 1921-34, when the range of fluctuation was very wide indeed, and it might well be that in the future fluctuations would be confined to narrower limits, with the result that the net premiums would prove to be greater than was necessary to cover the risk. It is possible, of course, that there may be "selection" against our hypothetical insurance company in the same way that there is frequently "selection" against a life assurance office, the man with a poor opinion of his prospects of living to an old age tending to take out a whole-life in preference to an endowment

TABLE XI.

Net Premiums to Insure against a Rise or Fall of 1d. per lb. or more in the Price of English Hides over 20 Weeks, Claims to be Equal to the Excess of the Rise or Fall over 7/8d. per lb.

Central Value of p (in Eighthths-of-a-penny per lb.) for Hide				Premium (in Eighthths-of-a-penny per lb.) to Insure Against a .	
(i).	(ii).	(iii).	(iv) and (v).	Rise in Price.	Fall in Price.
				In excess of 7 (eighthths).	
95	89	86	83	0.1	5.9
92	86	83	80	0.3	5.2
89	83	80	77	0.6	4.5
86	80	77	74	0.8	3.9
83	77	74	71	0.9	3.4
80	74	71	68	0.9	2.9
77	71	68	65	1.0	2.4
74	68	65	62	1.0	2.0
71	65	62	59	1.1	1.7
68	62	59	56	1.2	1.4
65	59	56	53	1.2	1.2
62	56	53	50	1.3	1.0
59	53	50	47	1.5	0.8
56	50	47	44	1.7	0.7
53	47	44	41	1.9	0.6
50	44	41	38	2.2	0.5
47	41	38	35	2.6	0.3
44	38	35	32	3.0	0.2
41	35	32	29	3.5	0.1
38	32	29	26	4.2	0.1

assurance, and the man with a good opinion of his chance of surviving to an old age taking out an endowment rather than a whole-life policy. An astute tanner might be prepared to pay the premium required to ensure against a fall in price within the next 20 weeks if he thought there was every prospect of a fall, but would be loath to do so if he considered that there was a good chance of a further rise, although on both occasions the adjusted spot price was the same.

The premiums in Tables X and XI must therefore be accepted with reservation. They do indicate, however, that it might be possible to obtain perfect price insurance at a cost which is not prohibitive.

Conclusions.

The primary object of this paper, as indicated in the first section, was to investigate whether the adoption of future trading in a particular commodity—hides—has been of real benefit to the trade concerned. The two principal claims made on behalf of future trading are (a) it tends to reduce major price fluctuations, and (b)

it offers a means of price insurance by the facilities afforded for hedging. The analysis has shown: (a) there is no evidence that the introduction of future trading in America has had any damping effect on hide-price fluctuations, in fact, the evidence tends to point in the opposite direction, and (b) hedging has only provided imperfect price insurance, in some cases the operator making unexpected profits and in others heavy losses. Investigation of an alternative method of price insurance suggests that this might be worthy of more attention than has been given to it in the past.

DISCUSSION ON MR. WHITE'S PAPER.

MR. R. G. HAWTREY: I am very glad to have the privilege of proposing a vote of thanks for this extremely instructive paper. It deals with a subject that the Society has not had occasion to consider for a very long time, and is full of new and interesting material.

Mr. White started off with a definition of what a futures market is, and it is a good working definition. But I am not sure that it quite brings out what I believe to be legally and practically the real essence of the matter—that is, that a forward market is one dealing in debts in terms of commodities. A forward seller is a debtor of the commodity, just as, in the case of a bank, when you deposit money in the bank the bank becomes a debtor for the amount and remains free to use the money as it pleases. A stockbroker who sells you stock becomes a debtor for that amount of stock, but there is no particular item of stock which becomes your property; he remains free, for example, to pledge any stock that he has on his hands for a loan. The legal relation of being debtor in a commodity is distinguishable from that of being a trustee, or receiving a particular possession which has itself to be restored to the owner.

There is a fable of a man who intended to shoot a bear, and sold the skin before he shot the bear. If his contract was to deliver the skin of that particular bear, his failure to shoot the bear made the contract incapable of execution. But if he was a seller in a future market, he could resort to the device favoured by unsuccessful anglers—that of a visit to the fishmonger.

Experts in mythology tell us that when a mythical character is associated with an animal, sometimes the mythical character *was* originally the animal—the story of Europa riding on the bull was preceded by an earlier version in which Europa *was* the bull. So I suspect the man in the fable was himself the bear.

I am getting a long way from the paper, on which there are a number of interesting and important statistical points that might be raised.

In the first place, with regard to the steadying of the market, I do not think it is quite accurate to say that what a futures market

ought to do is to diminish fluctuations; rather I would put it this way, that in a market without any forward business, the fluctuations in prices are more irresponsible. If there is no forward market, the market will not react in the same way to an expected rise in price as to an expected fall. In the case of an expected rise, everyone operating in the market who believes the rise is coming, is perfectly free to go and buy whatever amount of the commodity is offered in the market. But under those conditions when there is the anticipation of a fall of price, as soon as the pessimists, who expect the fall, have disposed of any stocks on their hands, and have abstained from buying further stocks, they are out of the market, and it is entirely in the hands of the optimists, so that there is a less balanced foresight than if all the dealers were simultaneously bringing their resources to bear on the market. If the pessimists are free to sell to the extent that their resources allow, their anticipations will affect the price continuously and to the full extent of the resources they have. There will therefore be a more responsible market. That applies almost exclusively to an anticipated fall of price, and not to the same extent to an anticipated rise. The practical advantage of the forward market is that the anticipated fall of price, whether excess of supply or failure of demand, is provided for beforehand, and does not take the market by surprise when it comes. So the fluctuations, although they may not be any less, are less harmful. Consequently I am not discouraged by that statistical investigation indicating that the forward market in the United States seems to have increased rather than decreased the fluctuation.

I feel a special interest in Table V, dealing with the spread between future and spot prices. It is very remarkable how large the spread was in the early months of the period dealt with. It began with the year 1931, when the monthly spread was two or three times the cost of holding stocks of hides, so that there must have been a very powerful bull speculation at work in that year. That throws a startling light upon the psychology of the United States in 1931. How far similar results could be found in other markets I do not know, but traders must have somehow thought that the demand in some directions was going to expand and that they had passed the worst of the depression.

A valuable investigation might be carried out into the light thrown by future markets in commodities of all kinds on the psychology of markets in connection with the trade cycle.

Mr. White gave some figures of the interest charge involved as part of the cost of holding stocks. The holding of stocks is the service which bridges the gap between spot and forward prices. He only gives the rate of interest averaged over the year, and it seems to me that does not do justice to the importance of the point. I have picked out one or two particular months, and I find that in the middle of 1934, in August, the interest charge per month was 0.018, which is substantially below the average. On the other hand, in June 1933, it was 0.044. The period taken is one in which interest rates were never very high—seldom more than 4 per cent.

But on going back to 1929 it will be found that in August of that year 6 per cent. had to be paid on a price which was somewhere between 18 and 20 cents per pound. Thus the interest charge was no less than 0.09, making a great difference to the normal spread per month.

I was rather surprised to find how high the charge for storage of hides was in New York. At the beginning of this period it was .12 of a cent per month, which is something like six times the cost of storing an equivalent weight of wheat. No doubt the wheat means somewhat larger bulk, and the cost of storage is mainly a question of space. But still the difference is startling.

I would like to say a word or two about the concluding proposal for insurance against a rise or fall of prices; it is interesting and ingenious, but open to one fundamental objection. The forward market sets off the prospect of a rise against the prospect of a fall of price for each individual who hedges; but if you insure only against a rise or only against a fall of price, you have to pay a relatively heavy premium. If the hedger wants to escape from speculative risks, he does it much better by foregoing the prospect of a price movement and leaving the market to set off one against the other. That could be done by a central official public agency; whether it could be as well done as by a market I am not so sure. The reactions of a public authority to market fluctuations are apt to be rather more mechanical than those of specialised dealers, so that I would not really anticipate much advantage from an insurance scheme on the lines indicated.

I do not want to end on a note of disagreement. I have found so much valuable and interesting material in the paper that I can only once again congratulate the reader of it.

MR. BARNARD ELLINGER: I am lost in admiration of the painstaking industry which has been devoted to the compilation of this paper, and I congratulate Mr. White on opening out a subject of investigation which I believe to be of the very highest importance to commerce and industry.

You must forgive me if I illustrate my remarks from the cotton futures market, and not from the hide futures market, with which I am quite unfamiliar. The cotton futures market is, of course, a wonderfully developed market; it is, I believe, possible to sell or buy futures in Liverpool for almost two years ahead; that is the market which we have for raw cotton. Our greatest competitors, the Japanese, have two other markets; they have a futures market in yarn, the process which is removed one stage from cotton, and in artificial-silk goods they have a futures market—I think, about six months ahead—for three types of artificial-silk cloth, plains, voiles and brocades. There has been no sufficient investigation of the advantages which these markets in futures bring to the Japanese in competition with ourselves, and I hope that Mr. White's paper will stimulate other people to make an investigation of this description, which may have to be undertaken on the spot.

I am much impressed with Mr. White's analysis, but I must

frankly confess I am more impressed with his analysis than with his conclusions. I think that arises largely from the periods he has selected. He warns us himself against the abnormalities in the years 1931-1935. I look with the very greatest suspicion on any long-term conclusions drawn from those years, with the exception possibly of one—that “all the world’s mad except thee and me, and even thee’s a bit queer.”

I think that the period selected accounts for the conclusion which Mr. White has drawn, that trade in futures has not evened out the market, and I think it also accounts to a considerable extent for his difficulties with the spread. I do not think you can hedge satisfactorily in a market which is entirely abnormal. I suppose the normal position in a futures market is that future months are quoted at spot price plus the cost and the interest of carrying the commodity. At the present moment I do not know how you would hedge in cotton at all. The American spot price of cotton to-day is about 10 per cent. dearer than the price of cotton eight or ten months ahead. The normal position is that the merchant buying cotton as it comes into the market towns in America, which he anticipates selling six or eight months ahead, buys his cotton and sells his futures at a price which shows him a profit on the spot price he has paid: but if he has to sell his futures at a price which shows him a loss of 10 per cent., I do not think he is going to be able to hedge, and, as far as I understand them, on looking at Mr. White’s figures for hides, they seem to me in the later years also to be very abnormal figures for the purpose of hedging. I would like to see the enquiry made in some other commodity over a period which is very much more normal, but it is difficult in these days to find a normal period; we might have to go back to a period before the war, but if you took Mr. White’s investigation into cotton and wheat in a normal period, would his conclusions be borne out?

As regards the insurance scheme, I would like to say two things. In the first place, it is too dear. Even on the figures that Mr. White gives it is going to cost at the cheapest—something like $3\frac{1}{2}$ per cent. for twenty weeks, so that a man doing this trade during the course of the year, would be paying something like $8\frac{1}{2}$ per cent. on his turnover. In the second place, I do not think he would be bettering his position by insuring, for in normal times the hedge is more or less watertight, and in abnormal times I do not think the insurance company would insure at normal premiums.

The imperfect hedge, however, often arises because the hedger changes his mind: he puts out a hedge in January for cotton that he has bought anticipating selling it in July, so he sells forward for delivery in July. He has misjudged his market, and the demand for his stock comes along in March instead of July, so he then sells his stock cotton in March and still has his position open in July, and because the hedge is changed, he falls into the ditch.

I should like to follow Mr. Hawtrey’s example—not in trying to hedge bear skins in fishmongers’ shops—but to end on a note of very hearty congratulation to the reader of the paper, and I have great pleasure in seconding this vote of thanks.

MR. OWEN JONES doubted whether a really satisfactory investigation on similar lines could possibly be carried out in one of our great commodity markets where futures trading has been maintained for many decades.

One distinguished member of this Society has presided over a Commission to enquire into trading in grain futures, and this Commission retreated from the task of making a quantitative statement of the effects of futures on prices. It was satisfied that these effects are not statistically determinable.

Now, one thing is inevitable to-night, Mr. Chairman. Unless you are prepared to enforce a most dictatorial control over the proceedings, the assembly will insist on applying, or rejecting, the conclusions of this paper not with reference to trading in hides and skins, but with reference to trading in futures in general.

I shall therefore try to keep to hides and skins. What strikes me is the broad conclusion that futures trading in hides and skins has failed to provide a reasonable hedge against price fluctuations. Since future trading in other commodities is reputed to perform this function, one must first examine whether there are any circumstances peculiar to the New York Hide Market which have caused it to behave in this presumably unusual way.

Now, the first discovery I made was that future trading does not claim to provide a perfect hedge. The price assurance is everywhere only approximative, and in certain circumstances it can be a long way out. Nor is there a substantial claim that future trading does away with fluctuations. It merely superimposes and substitutes a new series of fluctuations.

But these differences described by Mr. White must, I honestly believe, be much larger than those which are current in other markets.

Why should this be so? I can only ask questions. Is Mr. White satisfied that the New York Exchange has provided that wide volume of business which is essential to the proper working of a market? The figures of transactions as quoted by him leave me very sceptical, for it seems to me that the volume of trading in New York has been much too slight—in other words, the market has been too narrow for any of these conclusions to be applied to futures trading in general.

Another very important question relates to the basic futures contract. What is the range of grades deliverable or tenderable under the contract? This is not very clear. The basic grade is this Hide which Mr. White calls Hide A. Is it a very clearly ascertainable grade or quality within narrow limits? It looks so to me, but I may be wrong. In any case, it is necessary to point out that in the larger markets there is quite a wide range of quality tenderable against a futures contract. No cotton market, for example, would care to establish a futures market in one grade alone, such as "strict middling." This adventure would be universally acclaimed as unworkable.

I seem to be pursuing a train of personal and private suspicions against these calculations from the Hide Market. They may be quite unjustified, and Mr. White will set my mind at rest. What

I have just said about the range of tenderable quality brings me to another doubt. I am about to refer to what in some markets—at any rate in cotton—is called *basis*. To have to define basis in a few words is not a fair test to any man, but the following is an attempt:—

Basis is the relation between the basic futures contract (against which many grades can be tendered) and an even running lot of the spot commodity. It thus means the grade differences above or below the spot commodity, and it also means the premium or discount of the spot commodity in relation to the futures price. These differences will contain many variable factors, such as the time utility, and the place utility, and also the variable supply and demand for a particular grade in relation to other grades.

I confess that with all my effort I have only given a vague definition. The important point is that in cotton, and I think in wheat, the futures contract does not give a hedge for basis. It does not attempt to do so. I have a suspicion that Mr. White's compilations are an attempt to show that the New York contract has failed to provide a hedge for basis.

MR. GEORGE RAE wished to add his thanks to those accorded to Mr. White for his interesting paper. He had very few remarks to make, because most of the points which he had in mind had already been made by the three previous speakers.

The market in which he was primarily interested was rubber. The rubber market and the rubber exchange seemed to follow to some extent the procedure which Mr. White had shown for the hide exchange, but in rubber there was a good deal more outside speculation. Mr. White had indicated that the institution of the hide exchange had not damped down fluctuation in prices; that, of course, was rather difficult to prove, because it was so difficult to get definite information. The opinion of the rubber market was that the exchange had damped down fluctuations, at any rate, short-term fluctuations although it was not used much by manufacturers.

Mr. Rae thought that price stability within reasonable limits was something worth trying for, although hedging, apparently, was not very successful.

Mr. White's interesting suggestions on the price insurance scheme had been criticized, and with most of the criticisms Mr. Rae felt himself in agreement, but there was one point that had not yet been brought out, and that was the basis on which the premiums could be calculated. Mr. White had taken fourteen years ending with 1935, and on the price system there he had calculated a certain premium. He had pointed out, of course, the danger of selection against insurance companies, which meant adding a little to the premium, for the insurance company would have to protect itself. What was more important was that the price system itself would be liable to change. If, for example, the inhabitants of the world were suddenly converted to vegetarianism and cattle were raised purely for the provision of hides, the price of hides would go up,

and premiums calculated on the last fourteen years would be of little value. That, of course, was a fantastic suggestion, but there was a good deal to be said for the fact that prices did move, and insurance companies would have to take that into account. Nevertheless, he thought this was a line that might be worth pursuing even if it led to a negative result.

Finally, Mr. Rae once again thanked Mr. White for his interesting paper.

MR. GAMPELL said that the title and the conclusions of this paper, and all such portions coming between the title and the conclusions as he was able to understand—appeared to him to be misleading or erroneous. It would thus be in accordance with the traditions of the Society if he warmly congratulated Mr. White on the ability and energy he had displayed.

The title, as it stood, conveyed an impression that futures markets were being discussed generically; but the paper, in fact, examined only one unrepresentative market in abnormal circumstances. It did not prove that the principle of hedging is unsound, but only showed that the New York Hide Exchange had suffered from growing-pains.

Traders on the grain and cotton markets were emphatic that produce could be brought forward to this country at the present extremely low margins solely because of hedging facilities, and that futures trading notably reduced the spread between primary producer and ultimate consumer. Since they spent their lives working the system, there was a presumption that they knew something about it, and their contention had been upheld by impartial investigations such as that which Sir Josiah Stamp conducted at Winnipeg and by others which had an initial bias against the system. Mr. White disagreed because his case was abnormal. During the brief life of the Hide Exchange, the United States had suffered two genuine panics. The hide market was specifically disturbed by the AAA's slaughter of more than 7 million cattle under its drought-relief and surplus-disposal operations, and by the uncertainty as to how the by-product hides would be marketed. His finding that United States prices had been less stable than British prices thus did not disturb the conclusion, for which there was overwhelming evidence that futures trading normally exercised a great stabilizing influence. In wheat, for instance, prices in countries with hedging markets, such as England or America, were at least five times as stable as in non-hedging countries such as Italy.

Other abnormalities of this particular market were the divorce between cash and futures trading, the relatively small speculative turnover, the fact that the article was a by-product and the persistence of forward premiums; above all, its local character. A futures market did not consist merely of an annular piece of wood erected in a convenient building. It required the patient and steady up-building of trade contacts in all parts of the world. The Hide Exchange had made great progress, but was still only a lusty infant and might be spared heavy artillery until it was grown.

The leading international news agency gave about 120 times as much coverage to wheat or cotton futures as to hide futures—this despite the fact that the number of *cash* hide markets to which coverage was given throughout the world was extraordinarily large. Rubber futures were under the same New York auspices as hides (the Commodity Exchange Inc.), but got about 50 times the coverage. One could not expect hides to derive the same benefits from the focussing of world interest as do the great markets with 50 or 100 times the international interest.

Mr. Gampell characterized Mr. White's assumption that professional speculators make so much money that their functions could be more cheaply performed by an insurance company as ingenuous and incorrect. The Food Research Institute (*Wheat Studies*, July 1931) reckoned that the speculators who took up the hedges on the United States visible supply of wheat in 1921-1929 lost \$191,000,000 and paid another \$135,000,000 in brokerages for the privilege of losing it. Thus Mr. White might have difficulty in convincing his insurance company of the actuarial profitability of his proposals. The detail of Mr. White's proposal bore a close resemblance to "privileges" or "put-and-call options." These lent themselves to gambling and market-rigging—so much so that many of the futures markets have had to suppress or rigorously restrict them.

One important claim for futures trading, omitted from the tabulation on p. 298, was that it conduced to impartial statistics. Traders and speculators could as readily profit from bullish as from bearish situations, and all they desired was to have the facts of the situation presented in true perspective. To that end they spared neither money nor pains, and the Commodity Exchange Inc. is doing exemplary work in this field of collecting and disseminating accurate statistics on behalf of its futures markets, including hides.

Not so with the alternative systems. *Pace* Mr. White, the choice is not between futures markets and insurance companies, because the insurance companies, despite their diligent search for profitable outlets, have never yet shown any desire to enter this field. The choice is between futures markets and pools or marketing boards. In general, those boards have no such record of success as would induce one to discard the tested mechanism of futures trading. In particular they are statistically suspect. When your board wants to induce producers to curtail the supplies they are unloading on to it, it puts out bearish statistics. When it wants to unload its own stocks, it puts out bullish statistics. And it may keep a third set for general political purposes. Some of those present will recall a recent informal dinner at which the statisticians and marketing officers of some of the great statutory public boards which were now taking over the government and business of this country were strangely unanimous in preaching a doctrine of autocracy by obscurantism. They thought that their Boards' charters should be confirmed for at least ten years without possibility of Parliamentary recall, and that they should issue as few statistics as possible (best of all, none), lest they be used against the Boards in negotiation or

public discussion. They asked for a new type of statistics, resting less on the theory of probability. Perhaps the theory of relativity would suit them better—you adjust the figures according to the purpose for which you are going to use them. That is the thin end of a nasty wedge—the “authoritarian” countries have all suppressed their futures markets. As statisticians concerned for our profession, we cannot afford to be impartial as between enlightenment and obscurantism.

MR. O'TOOLE felt that most of what he was going to say had been already covered by other speakers. He agreed with the majority of the other speakers that this hide market did seem to suffer from growing-pains and from the fact that it was a very narrow and restricted market, with the result that many times throughout the year the buyer must go into the market and be unable to find his contra-party, with the result of a lowering of price.

With regard to the question of the big spread, he thought this was due to the fact that in its infancy, when these markets were formed, they always started with bullish tendencies; everyone thought trade was going to be big and fine, and the tendency was for all markets when they started to start bullishly. Also, the rent and storage charges of the wharfs were probably much higher than they need be, and possibly in the early days the interest charges were much higher in America than in ultimate years. After a few years the committees met and tried to get a reduction in storage, and probably that had happened in the hide market and accounted for the spread having become smaller.

MR. BUCHANAN felt that so much had been said that evening by other representatives of the commodity market that there was very little left for the remaining market experts to speak about. He had had 50 years' experience in metal and commodity exchanges, and he would be sorry if the Royal Statistical Society took the meaning that he was inclined to take from the lecturer's remarks, that there was something wrong with the idea of using future markets. As a financial expert, he knew that with a properly constituted future market, conducted on carefully drawn-up lines, protecting the buyer and the seller and the consuming public at home and abroad, it was possible to carry the stocks of commodities necessary for the world's trade at $1\frac{1}{2}$ per cent. interest with a 10 per cent. margin cover. If it were not for these future markets, the rate of interest would be 5 per cent. and the margin 50 per cent. Merchant Houses, buying the produce of Malaya and the Dutch East Indies and selling it to London, seldom found this to be possible at a profit, and where there is no future market on which to hedge, such business is speculation and not trade. The lecturer seemed to admit that hedging gives an insurance, and all insurance costs money.

With regard to the New York Hide Exchange, he could not speak from personal experience, but having visited the leading Exchanges in the United States and on the Continent of Europe, he infinitely preferred trading as conducted in London and Liverpool.

With regard to stabilizing commodities, if the table of monthly prices in *The Times* is studied, it will be seen that there is only one commodity stable from 1913 to 1936. If the lecturer believes that the users of that commodity are more satisfied, now that they have to pay a fixed price for that commodity fixed when the combine was started, than they were in the old days when it was a free market, he would be surprised, as few works can afford to have the costs of their raw material doubled.

Mr. Buchanan said he would like to thank the lecturer for the great amount of trouble he had taken in the preparation of his paper and the interesting tables. He would also like to thank the Society for extending to him the privilege of coming down and speaking to them from the merchant standpoint, as during the war he and his colleagues were called "merchant parasites"!

THE CHAIRMAN said they had had the privilege of hearing men of great practical experience: he now suggested that an academic statistician should close the discussion, and had pleasure in calling upon Sir Alfred Flux.

SIR ALFRED FLUX said he felt much honoured to be selected among those present to fill that little gap of time left for the discussion, and would try not to go beyond the time limit.

Most of the points in his own mind had been dealt with more or less, and therefore he proposed, in adding his thanks to those of other speakers to Mr. White for the paper he had put before the Society, to call attention to one point on which he had been hoping to hear something from the experts present. That point was the suitability of hides to be the subject of futures market. He might be prejudiced by the fact that when he was at Mr. White's age it was necessary to study cotton and wheat futures, because there was not much else to study. As shown in the paper, however, the quality of hides varied considerably with the season, so that there were notable differences between a November hide, a February hide and a July hide, and these could not, in the nature of things, be considered as equivalent units. When one considered what it would mean if, on a future contract in Egyptian cotton, it were possible to deliver American or Indian cotton, it would be realized that, while this was somewhat beyond what could be done in hides, it was the kind of thing about which they had been told. It could not be expected that a close cover for risks could be obtained in those conditions. He could only wish that, encouraged by Mr. White's example, some other Fellows could get together material—say from the rubber market, or some other commodity market where the spot product did not consist of such widely different articles, and investigate the matter further.

He did not find quite sufficient in the paper to justify him in feeling that the table given on p. 305 expressed the real relation of the pelt or hide from an animal killed in February to that from one killed in July. Variations in demand in the spot markets for these different commodities could not be ignored. There were

separate futures contracts for more than one class of North American wheat and for wheat from other places, while, if he understood the paper aright, the New York hides contract covered both American and Argentine hides; he would not have been surprised to learn that they were very different commodities. At the same time, the courage Mr. White had shown, and the example he had given to other Fellows of the Society, would, he hoped, make the presentation of this paper an extremely advantageous thing for the Society.

THE CHAIRMAN now put the vote of thanks to the meeting, and this was carried unanimously. He said that as President of the Society, he listened to a very wide range of papers, and usually attempted to make some remarks, but even the utmost human impudence had its limits, and his limits were now reached. He was not entirely clear what a future market was, nor whether persons who used it were saviours of Society or a kind of pirate, but he was quite sure many gentlemen present did know.

Some, he gathered, disagreed with the author, and attacked the paper. He would like to assure Mr. White that it was all done in kindness, and that also he had the priceless advantage not merely of having the last word, but the last pen. It was not necessary for the reader of a paper to reply orally: he could think out what he wished to say, and would have his critics delivered into his hands, because their finally corrected remarks would be submitted to him; they would have no opportunity for revision in the light of the author's reply.

MR. DOUGLAS SCRIVEN sent the following contribution after the meeting:—

I should like to thank the Society very cordially for their kindness in inviting me to be present at the discussion on the working of an exchange in "Futures" as applied to the hide trade, based on a paper read by Mr. G. Ronald White.

From the discussion it was quite evident that other trades find this form of trading to be helpful, yet, as an active merchant in hides and skins, I must strongly support the findings of Mr. White. Why, then, is there this difference? I think that it can be accounted for as follows:—

1. Because the finished product (leather) very frequently does not move in price relationship with the raw article (hides). Hides often advance when leather is declining in price.

2. Because, in order to avoid squeezing, a certain latitude in tendering is given over and above that mentioned by Mr. White, which does not really conform with the requirements of the user. It is of no interest to a tanner who has bought hides out of which to make stout leather, to run the risk of having tendered to him hides suitable for thin leather—with an allowance.

3. Because, in practical working, hides of one origin which are too dear in price can be replaced by a tanner with

hides of another and cheaper origin. The resultant leather may not be identical, but, nevertheless, can be sold at its value and show a profit to the tanner. The hides which are taken as a standard for the Futures Exchange are, however, those which are rather liable to price fluctuations, since they are used universally throughout the world, whilst, owing to the restrictions and quotas, it is not possible for a tanner to sell his leather in the best possible world market.

4. Because the Hide Futures Exchange started and is situated in America and is subject to the mercurial operations which are so characteristic of the Americans.

With regard to the suggestion of insuring the risk of price fluctuation, it appears to me that there may be a considerable risk of the insurance company which covered the risk against a rise becoming the victim of a conspiracy to force up prices temporarily.

Again, the insurance companies' chances of receiving enquiries to cover against a decline would surely be much smaller, since a tanner or merchant sets out to buy his raw material at a price which will show him a profit based on the price of the finished article. In other words, the insurance companies would only be asked to cover the risk one way, which would deprive them of the "smooths" which go to balance the "roughs," and thus the rates would have to be prohibitive.

MR. WHITE, in reply, thanked the meeting for the reception given to his paper, and expressed his pleasure at the lively discussion which it had produced. In writing the paper, he had endeavoured to make it quite clear that he was in no way attempting to generalize from the particular, but he was afraid one or two of the speakers had not realized this. He had carried out a statistical experiment using the New York Hide Exchange as his subject, and he had not the slightest intention that any remarks which he made or any conclusions which he drew regarding future trading on the New York Hide Exchange should be taken as applying to future trading on any other commodity exchange. Further, he had pointed out in the paper that any conclusions which he had drawn applied only to the past six and a half years' experience. It might be that in the next six and a half years the experience on the New York Hide Exchange would be entirely different, but he was not attempting to extrapolate into the future.

The following has since been received from Mr. White :—

It is not necessary for me to reply to those criticisms which are based on the assumption that I was attempting to apply conclusions drawn from the experience on the Hide Exchange to future trading in general, and I will therefore confine my attention to the remaining points.

A number of speakers implied by their remarks that they wished the investigation had been made in respect of one of the longer-established and wider futures markets. I readily admit that any conclusions drawn from the hedging experience on such a market

might well have been more favourable to the market than in the case of hides, but with a futures market such as cotton, wheat, or rubber, it would be impossible to carry out my first experiment, viz. to see whether there was any evidence that future trading had had a "damping" effect on price fluctuations. It is just because the futures market in hides is not a world market that it is worth while comparing variations in American and English hide prices. The magnitude of the business on the exchange has not been so small that it could have failed to influence American hide prices, and, at the same time, it has not been large enough to have repercussions on English hide prices.

Mr. Hawtrey has drawn attention to the variation from month to month in the interest charge involved as part of the cost of holding stocks. In order to indicate the extent of this variation, I give below, for each year of the period covered by Table V, the high and low values of the interest charge based on the average monthly prices of Hide A. The figures in brackets show the corresponding average futures spread per month (taken over three months)—

Range of Interest Charge per Month.

					High.	Low.
					cents per lb. per month.	
July/Dec. 1931	...	...	...	...	0.039 (0.45)	0.024 (0.28)
1932					0.028 (0.20)	0.016 (0.21)
1933					0.045 (0.12)	0.016 (0.12)
1934					0.031 (0.26)	0.019 (0.08)
1935					0.027 (0.11)	0.018 (0.11)

During this period the interest charge has been a comparatively small proportion of the total carrying charge in the case of hides, and variations in the interest charge have not always been reflected in the spread of futures prices. In the summer of 1929, when, as Mr. Hawtrey pointed out, the interest charge reached the figure of 0.09 cents per pound per month, the variations in average spread from day to day were so great that no reliable comparison is possible.

Mr. Owen Jones asks what is the range of grades deliverable or tenderable under the Hide Exchange contract. There are actually fourteen grades of U.S.A. native hides and four grades of Argentine hides, and as I pointed out on page 300, more than half the annual consumption of hides in the United States is of grades which are deliverable against an exchange contract. For this reason, the manufacturer taking delivery against an exchange contract runs the risk that he will receive raw material quite unsuitable for his purpose, but this is no different from the position of a cotton-spinner taking delivery against a cotton futures contract. The founders of the New York Hide Exchange did not expect tanners taking delivery against exchange contracts in order to obtain the actual physical hides they required, any more than the cotton trade would expect spinners to make a practice of taking delivery against cotton futures contracts in order to obtain their raw cotton. Before leaving the subject of the grades of hides deliverable against

an exchange contract, I should like to assure Sir Alfred Flux that although there is an appreciable difference in the value per lb. of a February hide and a July hide, this is mainly due to the variation in the water, hair, dirt and extraneous matter associated with the hide, and there is very little difference in the actual pelt or leather-producing substance from the two hides. Sir Alfred also refers to the fact that both American and Argentine hides are deliverable against an exchange contract. The difference between a Chicago heavy packer steer hide and an Argentine Frigorifico ox hide is much less than between the former and a Chicago light native cow hide. A sole leather tanner could change over from the first to the second class, but he would find the light native cow hide quite unsuitable for his purpose. The position is not parallel, therefore, with that of American and Egyptian cotton.

I think Mr. Gampell has an exaggerated idea of the extent of the disturbance caused to the American hide market by the slaughter of the "drought cattle" in 1934. Reference to Table A shows that in 1934 C.V.(A) was less than in either of the two previous years, while C.V.(B) was less than in any of the four previous years.

A number of speakers referred to the question of insurance. Mr. Ellinger considered that it was too dear, but I would point out that the fluctuations in hide prices are very much greater than in the majority of commodities (as will be seen from Tables VI, VII and VIII), and compared with the cost of insurance by means of hedging, the figure of $3\frac{1}{2}$ per cent. for twenty weeks, which he finds too dear, is really remarkably cheap. There appears to have been a certain amount of misunderstanding regarding the manner in which the premiums shown in Tables X and XI have been calculated. The premiums to insure against a rise in price are calculated on the assumption that a body of traders consistently insured against such a risk irrespective of the actual price level and irrespective of whether any other traders insured against a fall in price. Similarly, the premiums to insure against a fall in price are independent of the demand for insurance against a rise, but it is essential that the firms should insure *consistently*, and for that reason a long-term contract of insurance might be necessary. The claims paid at a time of rising prices to those who insured against a rise would be paid not out of the premiums received from those who had insured against a fall, but from the funds accumulated during periods of falling prices from premiums paid by those insuring against a rise.

As a result of the ballot taken during the meeting, the candidates named below were elected Fellows of the Society :—

Harry Cunningham, F.S.A.A.

Romesh Chandra Motilal Nanavati, F.C.I.

WHOLESALE PRICES IN 1935.

By THE EDITOR OF "THE STATIST."

(The Statist's Index Numbers in continuation of Mr. A. Sauerbeck's figures.)

THE following table records the Sauerbeck-Statist index numbers from 1846, *i.e.* from the commencement of the calculations, together with Jevons's figures adjusted to Sauerbeck's standard for the years 1810 and 1818. The all-commodities index numbers given in the table are based, with a few exceptions, on the average of fifty-two weekly quotations for forty-five commodities, and the averages for the standard period 1867-77 are taken as 100. The statistics were compiled to the end of 1912 by Mr. Augustus Sauerbeck, and subsequently by *The Statist*.

THE STATIST'S *Annual Index Numbers* (in continuation of
Sauerbeck's figures)
(1867-77 = 100.)

Year.	Average No.	Year.	Average No.	Year.	Average No.	Year.	Average No.	Year.	Average No.
1935	84	1916	136	1897	62	1879	83	1861	98
'34	82	'15	108	'96	61	'78	87	'60	99
'33	79	'14	85	'95	62	'77	94	1859	94
'32	80	'13	85	'94	63	'76	95	'58	91
'31	83	'12	85	'93	68	'75	96	'57	105
'30	97	'11	80	'92	68	'74	102	'56	101
'29	115	'10	78	'91	72	'73	111	'55	101
'28	120	1909	74	'90	72	'72	109	'54	102
'27	122	'08	73	1889	72	'71	100	'53	95
'26	126	'07	80	'88	70	'70	96	'52	78
'25	136	'06	77	'87	68	1869	98	'51	75
'24	139	'05	72	'86	69	'68	99	'50	77
'23	129	'04	70	'85	72	'67	100	1849	74
'22	131	'03	69	'84	76	'66	102	'48	78
'21	155	'02	69	'83	82	'65	101	'47	95
'20	251	'01	70	'82	84	'64	105	'46	89
1919	206	'00	75	'81	85	'63	103	'18	159*
'18	192	1899	68	'80	88	'62	101	'10	171*
'17	175	'98	64						

* Jevons's numbers adjusted.

For the year 1935 the annual all-commodities index number is 84, compared with 82 for the previous year. Thus during last year there was a continuation of the upward movement of prices which set in during 1934, but the rise in the index number has not so far been pronounced. Indeed, since 1931, the general price level has moved only slightly—downwards until 1933 and subsequently upwards—so that the index number for 1935 is one point higher than that for 1931. As far, therefore, as the course of prices is con-

cerned, the range of fluctuation since this country departed from the gold standard has been very limited—a result which independence of gold would be expected to produce, though it is necessary to remark that stability in sterling has also persisted over part of the period. If it be considered convenient or useful to refer to the immediate pre-war period as “normal”—a reference the validity of which depends upon the conditions of the particular problem in hand—then the post-1931 period is now practically normal from the point of view of the level of general prices obtaining. Last year’s index number (84) compares with 85 in the years 1912–14. The degree of “abnormality” which intervened between the two periods can be seen from the fact that the 1935 price level was 67 per cent. below that of 1920—the peak year—and 38 per cent. less than that of 1925. Those who continue to urge as the desideratum of practical policy a rise in general prices to the 1929 level (without explaining why the 1929 level is more desirable than any other) will have regard to the fact that the 1935 index number was 27 per cent. lower than that of 1929, and will be consoled only slightly by the recent rise in prices—a rise which is making the post-1931 range of price fluctuations greater than it was. The following table shows the ten-year averages of the index number since the commencement of the calculations; for the last ten years the average is lower than in any period since 1908–17.

THE STATIST'S *Annual Index Numbers—ten-year averages*
(1867–77).

1838–1847 = 93	1898–1907 = 71	1912–1921 = 148
'48–'57 = 89	'99–'08 = 72	'13–'22 = 153
'58–'67 = 99	'00–'09 = 73	'14–'23 = 157
'68–'77 = 100	1901–'10 = 73	'15–'24 = 162
'78–'87 = 79	'02–'11 = 74	'16–'25 = 165
'88–'97 = 67	'03–'12 = 76	'17–'26 = 164
'90–'99 = 66	'04–'13 = 77	'18–'27 = 159
'91–1900 = 66	'05–'14 = 79	'19–'28 = 152
'92–'01 = 66	'06–'15 = 82	'20–'29 = 142
'93–'02 = 66	'07–'16 = 88	'21–'30 = 127
'94–'03 = 66	'08–'17 = 98	'22–'31 = 120
'95–'04 = 67	'09–'18 = 110	'23–'32 = 115
'96–'05 = 68	'10–'19 = 123	'24–'33 = 110
'97–'06 = 70	'11–'20 = 146	'25–'34 = 104
		'26–'35 = 99

There can, however, be no doubt about the rising trend of prices, even if the rise is so far confined to narrow limits. By the end of last year the monthly all-commodities index number, as the table on the following page shows, had reached the level of 86·7. The index number had not been so high since February, 1932. Rather erratic but slight movements in the earlier months of 1935 gave way, after August, to a steady though moderate upward tendency. In general, the Italo-Abyssinian war may be given as a main cause of

Monthly Fluctuations of the Index Numbers* of 45 Commodities, 1867-77 = 100.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
1888	70.9	70.6	69.9	69.8	68.1	67.4	69.0	70.1	71.9	72.4	72.7	73.2	70
1892	70.0	70.0	69.1	68.0	68.8	67.7	67.8	67.4	66.8	67.4	68.2	67.7	68
'93	68.4	69.0	68.1	67.4	67.4	67.4	67.7	67.1	68.2	68.6	67.8	67.0	68
1894	65.8	65.0	64.3	63.8	63.1	63.1	62.6	63.0	62.7	61.7	60.8	60.1	63
'95	60.0	60.0	60.8	61.7	62.5	62.4	62.8	63.3	63.5	63.3	62.3	61.2	62
'96	61.4	61.4	60.7	60.3	60.1	59.3	59.2	59.7	61.2	62.6	62.6	62.0	61
'97	62.0	61.9	61.9	61.5	61.2	61.3	61.7	63.2	63.4	62.7	62.4	62.4	62
'98	62.8	63.4	63.0	65.5	66.4	64.7	64.3	64.0	63.9	63.6	63.9	63.8	64
1899	65.4	65.8	65.6	66.1	66.6	66.9	67.9	68.3	70.0	71.5	71.6	72.3	68
1900	74.0	75.1	75.7	75.6	75.5	75.7	76.2	76.0	75.5	74.7	73.9	73.4	75
'01	72.2	71.7	71.0	70.6	70.5	69.8	69.5	69.8	69.6	69.6	69.0	68.4	70
'02	68.8	68.9	69.2	69.7	70.9	70.4	70.0	69.5	69.3	68.8	68.6	69.1	69
'03	69.5	70.2	70.4	69.4	69.6	69.5	69.5	70.0	69.1	69.0	69.0	70.0	69
1904	70.4	70.8	70.8	70.5	69.9	69.4	69.9	70.4	70.7	71.0	71.2	70.9	70
'05	71.2	71.4	71.8	72.0	71.7	72.0	72.5	72.3	72.4	73.2	74.2	74.9	72
'06	75.2	75.0	75.7	76.5	77.0	76.9	76.4	76.7	77.5	78.5	78.6	79.7	77
'07	80.0	80.7	80.0	80.7	82.4	82.0	81.1	79.4	79.1	78.8	76.7	76.2	80
'08	76.0	74.5	74.1	73.8	73.6	72.9	73.1	72.2	72.5	72.2	72.2	72.3	73
1909	72.0	71.9	72.4	74.3	75.4	75.1	75.2	74.9	74.7	75.2	75.5	76.3	74
'10	77.1	78.1	79.1	78.5	78.2	76.9	78.1	78.2	77.6	77.2	77.8	77.9	78
'11	78.5	78.6	78.9	80.0	80.3	80.0	78.9	79.5	80.3	80.7	80.6	80.9	80
'12	81.8	82.9	84.4	85.0	85.3	85.5	86.5	85.9	86.7	85.8	85.3	86.4	85
'13	86.4	86.4	86.7	86.2	85.7	84.1	84.2	85.0	85.7	84.5	83.3	83.8	85
1914	83.5	83.8	82.8	82.3	82.3	81.2	82.4	87.9	89.3	89.8	88.8	91.6	85
'15	96.4	100.9	103.7	105.9	107.2	106.4	106.4	107.0	107.8	110.0	113.1	118.4	108
'16	123.6	127.0	130.4	124.2	135.4	131.0	130.5	134.5	134.4	141.5	150.8	154.3	136
'17	159.3	164.0	169.0	173.0	175.0	180.4	176.9	175.7	176.4	180.6	182.9	185.1	175
'18	186.2	187.3	188.0	189.8	191.1	192.3	192.9	195.0	197.1	197.8	195.3	196.0	192
1919	190.1	187.7	184.7	184.6	194.6	199.4	206.4	212.7	214.8	224.3	231.0	235.2	206
'20	245.3	260.4	261.8	266.1	260.0	255.7	254.6	253.5	248.7	239.9	223.8	207.2	251
'21	197.2	183.0	177.2	169.8	162.2	155.8	158.2	154.3	149.4	138.4	136.7	133.6	155
'22	132.5	132.2	133.3	134.8	135.5	135.6	134.0	129.6	127.9	130.1	130.6	129.1	131
'23	130.2	131.9	132.7	134.0	132.2	127.9	124.8	125.0	127.8	127.7	132.4	133.2	129
1924	137.2	138.8	137.0	136.8	136.4	136.3	138.4	138.0	141.6	146.1	145.5	147.7	139
'25	144.8	143.1	140.1	137.5	135.7	131.2	134.3	134.3	132.7	130.2	132.9	130.4	136
'26	129.3	127.9	126.1	125.5	125.7	124.9	126.0	127.0	128.0	131.0	130.8	123.9	126
'27	123.1	124.1	123.6	123.3	123.8	123.1	122.0	122.8	121.5	120.6	121.5	121.4	122
'28	120.9	121.1	123.6	125.6	126.2	122.6	120.3	118.0	116.8	116.8	117.9	117.9	120
1929	117.0	120.1	120.5	116.5	113.0	113.1	115.2	113.9	112.6	111.1	108.3	108.8	115
'30	106.6	104.8	103.0	101.5	98.8	95.8	94.4	92.2	90.8	90.4	88.6	86.9	97
'31	85.7	85.5	85.5	84.4	82.2	82.6	80.2	79.1	80.7	82.3	83.0	85.4	83
'32	84.7	86.7	84.1	82.5	80.2	77.0	78.9	80.7	80.4	77.8	77.9	77.7	80
'33	77.8	77.0	77.0	78.5	80.9	81.3	81.7	81.2	80.7	80.5	79.3	80.0	79
1934	82.5	82.5	82.2	81.0	81.1	80.7	82.4	83.4	82.1	81.1	81.0	82.8	82
'35	83.6	83.4	82.9	84.1	85.2	83.7	84.3	84.1	85.1	85.8	86.3	86.7	84
'36	86.7	86.7	86.4										

* The average of the twelve monthly figures of each year does not necessarily coincide with the annual figures, as the latter are calculated mostly from the average of 52 weekly quotations, while the former are based on end-of-the-month prices.

the higher prices, and continued recovery of the national economy was also an important contributing factor.

Two groups—food and materials—make up the all-commodities index-number. In 1935 the annual index numbers for these two groups moved in opposite directions, but the divergence was slight. For food, the 1935 figure was 76, compared with 77 in 1934, and for materials the corresponding figures were 84 (1935) and 82 (1934). Of the three sections comprised in the food group, the index-number for vegetable foods was the only one to rise, and the index-number for the third, the sugar, coffee and tea section, fell sharply. In the

Summary of Index Numbers. Groups of Articles, 1867-77 = 100.

	Vegetable Food (Corn, etc.).	Animal Food (Meat, etc.).	Sugar, Coffee, and Tea.	Total Food.	Minerals.	Textiles.	Sundry Materials.	Total Materials.	Grand Total.	Silver.*	Wheat Harvest.†	Average Price of Consols.‡	Average Bank of England Rate ‡
1873.....	106	109	106	107	141	103	106	114	111	97.4	80	92½	4.750
'90.....	53	73	59	62	63	54	63	60	61	50.5	112	110½	2.483
1910.....	65	96	54	74	89	73	81	81	78	40.5	102	81½	3.725
'11.....	70	90	61	75	93	76	81	83	80	40.4	110	79½	3.467
1912.....	78	96	62	81	110	76	82	88	85	46.1	97	76½	3.776
'13.....	69	99	54	77	111	84	83	91	85	45.3	105	73½	4.771
'14.....	75	100	58	81	99	81	87	88	85	41.6	109	72½	4.038
'15.....	108	126	70	170	126	92	109	103	108	38.9	106	65½	5.000
'16.....	133	152	66	130	158	129	136	140	136	50.4	97	58½	5.470
1917.....	177	192	113	169	172	192	174	179	175	65.8	102	54½	5.15
'18.....	168	207	130	174	192	222	202	206	192	76.4	111	56½	5.0
'19.....	179	213	147	185	220	228	219	222	206	85.3	98	54½	5.166
'20.....	227	263	198	234	295	262	244	264	251	76.1	96	47½	6.71
'21.....	143	218	83	158	181	140	145	153	155	48.1	118	47½	6.092
1922.....	107	184	82	130	142	134	124	132	131	51.6	105	56½	3.692
'23.....	98	162	101	122	155	140	117	134	129	49.4	105	57½	3.496
'24.....	119	158	105	130	158	170	120	146	139	50.7	107	56½	4.0
'25.....	118	162	89	128	154	165	119	143	136	52.5	114	56½	4.575
'26.....	108	150	88	119	154	133	114	131	126	47.1	99	54½	5.0
1927.....	108	138	83	114	141	131	118	129	122	42.8	109	54½	4.650
'28.....	107	142	78	114	123	136	117	124	120	41.0	109	55½	4.5
'29.....	99	146	72	110	126	122	111	119	115	40.2	114	54½	5.508
'30.....	77	142	54	96	112	84	97	97	97	29.0	99	56½	3.4
'31.....	68	119	50	83	100	63	65	82	83	20.4	99	55½	3.975
1932.....	72	105	50	79	94	64	81	81	80	19.5	105	66½	3.017
'33.....	60	106	47	74	107	67	80	83	79	18.7	114	73½	2.0
'34.....	63	108	50	77	109	72	80	85	82	20.0	120	80½	2.0
'35.....	66	107	42	76	112	80	83	90	84	26.4	112	86½	2.0
Average													
1904-13	68	91	53	73	95	74	76	81	77	44.1	106	82½	3.733
1890-99	61	80	63	68	71	56	66	64	66	55.8	103	103½	2.958
'78-87	79	95	76	84	73	71	81	76	79	82.1	97	99½	3.264
1818-27	109	90	151	111	128	105	106	112	111	98.0	—	—	3.692

* Silver (see note on p. 351), parity of 1 gold to 15½ silver = 100.

† Wheat harvest in U.K. to 1895: 29 bushels = 100; from 1896: 30 bushels = 100.

‡ Average price of Consols and the average Bank of England rate of discount are actual figures, not index-numbers; Consols 3% to 1888, 2½% from 1889, 2½% from April, 1903.

materials group, the figures for textiles rose in more pronounced fashion than for minerals and sundry materials, the other two component sections of the group. Annual index numbers for the groups and sections are set out in the table on p. 346.

The following table records monthly movements of the index numbers for the groups and sections, and on the following page quarterly movements are given.

THE STATIST'S *Index Numbers—monthly averages by groups*
(1867-77 = 100).

	Vegetable Food.	Animal Food.	Sugar, Tea, and Coffee.	Food-stuffs.	Minerals.	Textiles.	Sundry Materials.	Materials.	All commodities
1933.									
Jan.	63.2	104.3	45.1	74.5	99.9	63.2	80.2	80.3	77.8
Feb.	59.9	105.1	47.5	74.0	99.4	60.8	79.7	79.2	77.0
March	57.5	108.7	49.3	74.6	99.9	61.9	77.5	78.8	77.0
April	58.6	110.9	47.9	75.6	103.9	64.3	77.8	80.7	78.5
May	58.5	108.2	48.0	74.6	112.1	69.5	81.7	85.4	80.9
June	60.3	106.1	46.4	74.2	113.2	72.3	80.0	86.5	81.3
July	62.3	105.9	46.9	75.1	110.7	72.4	81.2	86.5	81.7
Aug.	62.6	106.2	47.9	75.6	110.7	71.2	79.4	85.3	81.2
Sept.	61.0	105.4	48.8	74.8	111.6	69.3	79.5	85.0	80.7
Oct.	59.3	105.7	48.6	74.2	111.8	68.6	80.2	85.1	80.5
Nov.	58.1	105.0	46.7	73.0	110.5	66.9	79.4	83.9	79.3
Dec.	55.2	108.4	46.8	74.3	110.5	67.5	79.4	84.1	80.0
1934.									
Jan.	59.6	111.8	52.6	77.3	111.2	72.9	80.1	86.2	82.5
Feb.	59.7	111.3	53.2	77.3	111.5	73.9	79.3	86.3	82.5
March	58.8	107.3	53.1	75.5	112.5	74.0	80.4	87.0	82.8
April	57.8	107.8	52.8	75.2	110.5	70.8	79.6	85.2	81.0
May	58.2	113.3	52.5	76.6	107.8	71.1	79.4	84.5	81.1
June	60.1	109.8	51.3	76.6	106.8	70.6	78.4	83.6	80.7
July	70.4	109.8	49.4	80.5	107.3	71.1	77.9	83.7	82.4
Aug.	72.6	111.9	47.7	81.8	108.5	71.5	78.9	84.6	83.4
Sept.	70.1	106.9	47.0	78.8	109.8	69.6	79.4	84.5	82.1
Oct.	67.7	106.2	44.9	77.1	109.7	67.2	79.9	84.0	81.1
Nov.	66.7	104.4	44.8	75.9	109.4	71.2	78.8	84.7	81.0
Dec.	65.7	111.2	44.6	78.0	109.9	74.4	80.1	86.4	82.8
1935.									
Jan.	64.6	112.7	42.2	77.6	110.1	77.1	81.6	87.9	83.6
Feb.	64.5	112.0	40.7	77.0	107.4	77.8	83.3	88.0	83.4
March	64.0	108.9	40.9	75.7	109.1	77.2	82.9	88.2	82.9
April	65.4	108.8	42.6	76.6	112.0	78.8	83.0	89.6	84.1
May	70.1	108.1	42.6	78.3	113.4	79.6	83.1	90.2	85.2
June	65.7	106.9	41.7	75.8	111.6	79.7	82.3	89.4	83.7
July	68.9	105.4	40.1	76.3	114.4	80.5	81.6	90.1	84.3
Aug.	67.5	108.3	39.8	76.7	111.9	81.5	81.1	89.5	84.1
Sept.	70.1	106.0	41.8	77.4	115.2	78.4	84.2	90.8	85.1
Oct.	70.6	104.4	42.7	77.1	116.4	80.7	85.1	92.2	85.8
Nov.	69.2	103.9	41.6	76.1	117.4	85.3	85.0	93.4	86.3
Dec.	72.3	104.1	41.2	77.4	116.2	85.8	84.5	93.3	86.7
1936.									
Jan.	73.4	104.8	41.9	78.4	114.9	84.0	84.5	92.8	86.7
Feb.	71.9	104.9	41.0	77.6	116.9	84.1	85.1	93.3	86.7
March	71.0	104.1	40.8	76.8	116.6	84.7	84.8	93.3	86.4

*Quarterly Movements of Prices.**
Summary of Index Numbers, 1867-77 = 100.

Years.	Quar- ters.	Vege- table Food (Corn, etc.).	Animal Food (Meat, etc.).	Sugar, Coffee, and Tea.	Total Food.	Min- erals.	Tex- tiles.	Sund- ry Mate- rials.	Total Mate- rials.	Grand Total.	Sil- ver.†
1924	I	115.1	146.2	111.5	126.6	169.0	159.6	121.0	145.9	137.7	48.8
	II	118.3	155.3	97.2	127.5	156.7	165.2	118.4	143.1	136.5	49.9
	III	121.8	159.7	90.7	131.1	157.1	173.1	117.3	145.2	139.2	51.6
	IV	134.5	160.0	108.3	138.4	163.9	182.7	122.5	152.2	146.4	52.4
'25	I	129.0	165.6	98.8	136.1	157.0	171.6	123.9	147.5	142.7	51.6
	II	116.6	164.8	86.7	128.1	150.5	157.8	119.6	139.7	134.8	51.5
	III	112.6	163.3	83.5	125.2	153.9	159.2	117.3	140.1	133.8	53.3
	IV	108.9	155.1	82.6	120.4	153.7	159.8	114.5	139.0	131.2	53.1
'26	I	103.9	152.4	86.8	118.1	150.3	148.8	147.7	134.8	127.8	50.6
	II	104.1	155.0	88.4	119.5	143.0	135.7	113.7	129.7	125.4	49.3
	III	106.8	154.2	88.2	120.3	166.1	126.4	114.1	131.9	127.0	47.4
	IV	109.3	144.4	88.9	117.9	192.0	115.8	115.9	136.4	128.6	41.2
'27	I	108.1	143.4	85.4	116.1	155.0	120.7	118.3	128.9	123.6	43.0
	II	111.6	145.9	82.6	118.1	140.7	127.9	118.2	127.2	123.4	43.0
	III	106.9	138.1	80.8	112.9	133.3	139.8	118.1	128.8	122.1	42.1
	IV	104.5	132.1	82.0	110.0	132.8	138.6	120.6	129.5	121.2	43.3
'28	I	108.9	143.8	80.3	115.7	123.6	136.7	120.6	126.3	121.9	43.2
	II	118.0	152.0	81.1	122.8	122.9	140.6	117.9	126.3	124.8	44.7
	III	101.1	142.0	77.9	111.2	121.0	135.3	116.7	123.6	118.4	44.3
	IV	101.9	138.1	76.3	109.8	126.0	131.5	115.3	123.5	117.5	43.7
'29	I	102.9	142.7	75.4	111.8	130.2	130.7	116.6	124.6	119.2	42.8
	II	92.8	148.3	73.2	109.1	125.0	121.2	111.1	117.9	114.2	41.1
	III	99.9	143.4	71.7	110.0	126.9	115.6	111.1	116.7	113.9	39.6
	IV	91.3	145.2	64.2	105.4	122.9	107.9	108.7	112.3	109.4	37.3
'30	I	80.8	152.1	58.3	102.3	121.1	96.4	104.9	106.7	104.8	33.0
	II	76.7	142.4	56.5	96.5	110.8	92.4	99.5	100.4	98.7	29.8
	III	77.4	132.1	48.6	91.5	109.0	77.3	94.6	94.6	92.5	26.8
	IV	71.9	130.0	51.7	89.0	105.4	68.9	91.6	88.3	88.6	26.5
'31	I	69.0	127.3	48.6	86.2	103.4	62.7	89.8	85.1	85.6	21.8
	II	69.5	123.3	48.8	85.0	98.6	61.4	85.6	81.7	80.1	21.3
	III	70.0	117.4	47.0	81.4	98.5	58.6	81.6	79.0	83.0	21.9
	IV	75.7	107.9	53.7	82.9	102.2	60.9	85.4	84.1	83.6	21.5
'32	I	80.7	109.2	52.2	83.2	101.1	67.5	87.8	85.2	85.2	21.0
	II	77.6	107.6	50.2	82.9	95.1	59.4	79.6	77.3	79.9	19.4
	III	68.2	105.3	49.6	77.9	100.6	65.9	80.7	81.5	80.0	19.4
	IV	64.2	98.2	48.4	73.4	101.2	64.5	80.2	81.0	77.8	18.4
'33	I	60.2	106.0	47.3	74.4	99.7	62.0	79.1	79.4	77.3	18.2
	II	59.1	108.4	47.4	74.8	109.7	68.7	79.8	84.2	80.2	20.0
	III	62.0	105.8	47.9	75.2	111.0	71.0	80.0	85.6	81.2	18.5
	IV	58.5	106.4	47.4	73.8	110.9	67.7	79.7	84.4	79.9	18.5
'34	I	59.4	110.1	53.0	76.7	111.7	73.6	79.9	86.5	82.4	19.1
	II	58.7	110.3	52.2	76.1	108.4	70.8	79.1	84.4	80.9	18.6
	III	71.0	109.5	48.0	80.4	108.5	70.7	78.7	84.3	82.6	19.7
	IV	66.7	107.3	44.8	77.0	109.7	70.9	79.6	85.0	81.6	22.1
'35	I	64.4	111.2	41.3	76.8	108.9	77.4	82.6	88.0	83.3	23.0
	II	67.1	107.9	42.3	76.9	112.3	79.4	82.8	89.8	84.3	29.3
	III	68.8	106.6	40.6	76.8	113.8	80.1	82.3	90.1	84.5	27.3
	IV	70.7	104.1	41.8	76.9	116.7	83.6	84.9	93.0	86.3	25.7

* The averages of the four quarterly figures to each year do not necessarily coincide with the annual averages, as the latter are based as far as possible on average weekly prices. See also the *Journal*, 1893, p. 221; 1895, p. 144; 1901, p. 90; and 1909, p. 70.

† Silver, parity of 1 gold to 15½ silver = 100.

A study of the individual commodities shows that in the first section, vegetable food, most of the items were on average dearer in 1935 than in 1934. Lower average quotations were recorded only for barley and maize. The *Gazette* price of wheat was appreciably higher, and American wheat also was dearer. American wheat prices, especially, were affected by the bad harvests in North America and elsewhere, and the Italo-Abyssinian war tended also to raise quotations. Potatoes were on average much dearer, and the price in December, 1935, was 45 per cent. above that in December, 1934; the yield per acre was poor last year, but part of the rise in price is undoubtedly due to the functioning of the Potato Marketing Board. In the animal food section, the general tendency of prices was downwards, but prime mutton and butter were on balance dearer, though the first-named commodity became much cheaper towards the end of the year. The pronounced fall in the third food section was the result of a downward movement in prices of coffee and tea. Coffee was subjected to selling pressure during the year, and the price was also depressed by the Brazilian Government's withdrawal of market support; the fall in the price of tea occurred despite an improvement in the stocks position, and so far during the current year quotations have tended to increase. In the first of the materials sections, only one component item—tin—was on average cheaper than a year previously. This decrease in the average price of tin was only slight, for considerable stringency of supplies kept the price high during many months of the year, the fall in the average being produced by the very low prices obtaining during February and March following the failure of a group which had been speculating in a number of commodities. The increases in the index numbers for iron and iron bars were small; upward revisions in the price of iron resulted from great activity in the iron and steel industry, but were not effected until November. The price of copper improved on the institution of a form of production control and on increased consumption and speculation arising largely out of rearmament. Lead also was affected by the general move towards rearmament and by increased demand caused through industrial recovery. In the textiles section, imported wool was the only item for which the annual index number was lower than in 1934. Flax, hemp, jute and Oomra cotton were substantially dearer. Again, among the sundry materials, a miscellaneous section, the tendency in the case of most commodity prices was upwards. At the end of this article, on pages 354-59, are given the average prices and index numbers for all the commodities comprised in *The Statist* all-commodities index number since 1914, the figures for 1873 are also shown, and average prices for four ten-year periods.

Construction of the Tabular Statements.

The following table illustrates the method of construction of the index numbers. The index numbers here given are based on the average prices for the eleven years 1867-77. Take, for instance, the *Gazette* price of English wheat :—

		s.	d.	
Average, 1867-77 ...	54	6	= 100, average point.	
„ 1914 ...	35	0	= 64, or 36 per cent. below the average point.	
„ 1920 ...	80	7	= 148, „ 48 „ above „ „	
„ 1926 ...	53	3	= 98 „ 2 „ below „ „	

The individual index numbers, therefore, represent simple percentages of the average point.

The articles are grouped in six categories :—

		1867-77. Total Numbers.	Example for 1935.	
			Total Numbers.	Average.
1. Vegetable food, corn, etc. (wheat flour, barley, oats, maize, potatoes, and rice) ...	8 Index nos.	800	530	66
2. Animal food (beef, mutton, pork, bacon, and butter) ...				
3. Sugar, coffee, and tea ...				
1—3. Food ...	19	1,900	1,447	76
4. Minerals (iron, copper, tin, lead, and coal) ...	7	700	786	112
5. Textiles (cotton, flax, hemp, jute, wool, and silk) ...				
6. Sundry materials (hides, leather, tallow, oils, soda, nitrate, in- digo, and timber) ...				
4—6. Materials ...	26	2,600	2,339	90
General Average ...	45	4,500	3,786	84

The general average is drawn from all forty-five descriptions, which are treated as of equal value, and is the simple arithmetical mean as shown above.

Index of Silver Prices.

The base of the index numbers given below is 1 gold to 15½ silver = 100, 60.84*d.* per standard ounce being parity.*

	Price per oz. standard.	Index number.		Price per oz. standard.	Index number.
Average 1873 ...	<i>d.</i> 59½	=97.4	<i>Lowest Nov., 1902</i>	<i>d.</i> 21½	=35.6
" " '90-99...	34	=55.8	End Dec., 1906 ...	32½	=53.1
" " 1917-26...	40½	=66.6	" Dec., '08 ...	23½	=38.1
" " 1893 ...	35½	=58.6	" Dec., '12 ...	29	=47.7
" " '96 ...	30½	=50.5	" Dec., '13 ...	26½	=43.7
" " 1909 ...	23½	=38.9	" June, '14 ...	26	=42.7
" " '14 ...	25½	=41.6	" Dec., '14 ...	22½	=37.3
" " '15 ...	23½	=38.9	" Dec., '15 ...	26½	=43.1
" " '16 ...	31½	=50.4	" Dec., '16 ...	36½	=58.7
" " '17 ...	40½	=65.8	" Dec., '17 ...	43½	=70.0
" " '18 ...	47½	=76.4	" Dec., '18 ...	48½	=77.9
" " '19 ...	57	=85.3	" Dec., '19 ...	77½	=98.3
" " '20 ...	61½	=76.1	" Dec., '20 ...	40½	=49.2
" " '21 ...	36½	=48.1	" Dec., '21 ...	34½	=49.3
" " '22 ...	34½	=51.6	" Dec., '22 ...	31½	=49.6
" " '23 ...	31½	=49.4	" Dec., '23 ...	33½	=49.0
" " '24 ...	34	=50.7	" Dec., '24 ...	31½	=50.4
" " '25 ...	32½	=52.5	" Dec., '25 ...	31½	=52.1
" " '26 ...	28½	=47.1	" Dec., '26 ...	25	=41.1
" " '27 ...	26½	=42.8	" Dec., '27 ...	26½	=43.6
" " '28 ...	26½	=44.0	" Dec., '28 ...	26½	=43.3
" " '29 ...	24½	=40.2	" Dec., '29 ...	21½	=35.2
" " '30 ...	17½	=29.0	" Dec., '30 ...	14½	=23.7
" " '31 ...	14½	=20.4	" Dec., '31 ...	20½	=21.6
" " '32 ...	17½	=19.5	" Dec., '32 ...	16½	=17.2
" " '33 ...	18½	=18.7	" Dec., '33 ...	19½	=19.5
" " '34 ...	21½	=20.0	" Dec., '34 ...	24½	=22.6
" " '35 ...	29	=26.4	" Dec., '35 ...	22½	=20.6

* All the index numbers in the table from 1916 to 1925 inclusive and from 1931 to date are calculated on the basis of the gold prices of silver instead of the sterling prices, though the latter are the price quotations given in the table. In arriving at the index numbers for these dates the prices of gold are taken as follows. For 1916, 1917 and 1918 the price is taken as 86s. 9½*d.* per fine oz., derived from the "pegged" New York rate of \$4.76½ to the £. For 1919 the average price of gold is taken as 93s. 4½*d.*, this being the parity price with the U.S. dollar, the average New York exchange in that year being \$4.429. For the other dates the index numbers are based on the quotations in the London market for exportable gold. The quotation at the end of 1919 was 109s. 8½*d.* per fine oz. At the end of 1920, 1921, 1922, 1923 and 1924 the quotations per fine oz. were 116s. 1*d.*, 98s. 0*d.*, 88s. 11*d.*, 95s. 4*d.*, and 88s. 2*d.* respectively and the average quotations in these years were 112s. 11½*d.*, 107s. 0½*d.*, 93s. 4*d.*, 90s. 3*d.*, and 93s. 8½*d.* respectively, while the average price in 1925 was 85s. 5½*d.* The prices at the end of 1931, 1932, 1933, 1934 and 1935 were 121s. 11*d.*, 123s. 9*d.*, 126s. 6*d.*, 141s. 0*d.*, and 141s. 2*d.* respectively, and the average prices in these years were 92s. 6½*d.*, 118s. 0½*d.*, 124s. 10½*d.*, 137s. 7½*d.* and 142s. 1½*d.* respectively.

Silver rose rapidly in price in the early part of the year as a result of an intensification of the silver-buying policy of the United States

Government and of the speculation which that policy produced. However, the extent of official buying was uncertain at times, and a highly speculative position had been built up, so that there were sharp fluctuations in prices. When in December the United States Treasury first refrained from buying in the market at all, and then gave only a very limited support, there was a slump in the price of silver; the lowest price of the year—58 per cent. of the highest price—was reached on December 24, 1935, and *The Statist* index number for the end of December is the low figure of 20·6. The annual index number is higher than it has been since 1930. At 26·4, it compares with 20·0 for the year 1934. The United States policy of paying higher prices for domestic silver led to an increase in output from that country, and the world output was also stimulated. The following table gives the details :—

World's Production of Silver (in millions of ounces).

	United States.	Mexico.	Canada.	Australia.	Other Countries.	Total.
1902... ..	55·5	60·2	4·3	8·0	34·8	162·8
'03... ..	54·3	70·5	3·1	9·7	30·1	167·7
'04... ..	57·7	60·8	3·7	14·5	27·5	164·2
'05... ..	56·1	65·0	5·9	15·0	30·3	172·3
'06... ..	56·5	55·2	8·5	14·2	30·6	165·0
'07... ..	56·5	61·0	12·8	19·0	34·8	184·2
'08... ..	52·4	73·6	22·1	17·2	37·8	203·1
'09... ..	54·7	73·9	27·5	16·3	39·7	212·1
'10... ..	57·1	71·4	32·9	21·5	38·8	221·7
'11... ..	60·4	79·0	32·7	16·6	37·5	226·2
'12... ..	63·8	74·6	31·6	18·1	36·2	224·3
'13... ..	66·8	70·7	31·5	3·5	51·4	223·9
'14... ..	72·4	27·5	28·4	3·6	36·5	168·4
'15... ..	74·9	39·5	28·4	4·1	37·3	184·2
'16... ..	74·4	38·2	25·4	4·2	26·6	168·8
'17... ..	71·7	35·0	22·2	10·0	35·3	174·2
'18... ..	67·8	62·5	21·2	10·0	35·9	197·4
'19... ..	56·7	62·7	15·7	7·4	32·0	174·5
'20... ..	55·5	66·8	12·6	7·5	33·0	175·4
'21... ..	53·1	64·5	13·1	4·9	35·7	171·3
'22... ..	56·2	81·1	18·6	11·3	46·3	213·5
'23... ..	73·3	90·9	17·8	10·3	50·2	242·5
'24... ..	65·3	91·5	19·7	10·8	52·2	239·5
'25... ..	66·1	92·9	20·2	11·1	54·8	245·1
'26... ..	62·7	98·3	22·4	11·2	59·0	253·6
'27... ..	60·4	104·6	22·7	9·0	57·3	254·0
'28... ..	58·4	108·5	21·9	9·0	59·5	257·3
'29... ..	61·2	103·7	23·1	9·0	59·7	261·7
'30... ..	51·0	105·0	26·0	8·9	57·1	248·0
'31... ..	31·0	86·0	21·0	7·6	47·4	196·0
'32... ..	24·0	69·0	18·0	6·5	47·5	165·0
'33... ..	22·8	68·1	15·2	11·0	52·0	169·1
'34... ..	32·5	74·1	16·4	11·4	56·5	190·9
'35 *	38·0	72·0	16·0	8·9	71·1	206·0

* Provisional.

Gold.—The following table shows the world's annual gold production since 1850. Prior to 1911 the estimates are those of the Bureau of the U.S. Mint and other authorities. The value is taken throughout at £4.25 per fine oz. The estimate for 1935 is subject to revision. The figures show clearly the increase in output caused by the departure of the large producing countries from the gold standard (especially the departure of South Africa at the end of 1932).

(000's omitted.)

Year.	Value of output. £	Year.	Value of output. £
1850	11,600	1893	32,363
'51	17,200	'94	37,229
'52	26,550	'95	40,843
'53	31,090	'96	41,559
'54	25,490	'97	48,509
'55	27,015	'98	58,949
'56	29,520	'99	63,027
'57	26,655	1900	52,312
'58	24,930	'01	53,630
'59	24,970	'02	60,975
'60	23,850	'03	67,337
'61	22,760	'04	71,380
'62	21,550	'05	78,143
'63	21,390	'06	82,707
'64	22,600	'07	84,857
'65	24,040	'08	90,995
'66	24,220	'09	93,302
'67	22,805	'10	93,544
'68	21,945	'11	94,930
'69	21,245	'12	95,783
'70	21,370	'13	97,481
'71	25,400	'14	92,709
'72	24,200	'15	97,114
'73	23,600	'16	92,597
'74	22,950	'17	87,236
'75	22,700	'18	78,605
'76	22,540	'19	73,078
'77	23,830	'20	68,522
'78	22,020	'21	67,848
'79	21,400	'22	66,723
'80	22,130	'23	77,888
'81	21,150	'24	81,807
'82	20,500	'25	82,267
'83	20,640	'26	82,211
'84	20,830	'27	82,582
'85	21,250	'28	82,400*
'86	21,430	'29	83,200*
'87	21,735	'30	88,500
'88	22,644	'31	95,100*
'89	25,375	'32	103,400*
'90	24,421	'33	107,700*
'91	26,846	'34	117,400*
'92	30,134	'35	129,600

* Amended figures.

Average Prices of Commodities.*

No. of Article	Year.	Silver. d. per oz.	1		2	3	4	5	6	7	8	1-8	9	10
			Wheat.		Barley.	Oats.	Maize.	Potatoes.	Rice.	Vegetable Food.	Total.	Prime.	Midlin.	
			English Gazette. s. and d. per qr.	American. s. and d. per qr.	For New Male Wheat (now "G.R.") s. per sack (280 lbs.)	English Gazette. s. and d. per qr.	English Gazette. s. and d. per qr.	American Mixed. s. per qr.	Good English. s. per ton.					Rangoon Carries to Arrive. s. and d. per cwt.
1873 ...	50½	58-8	63	51	40-5	25-5	30	160	9-6	—	65	50		
1915 ...	23½	53-11	59-10	49	37-4	30-9	41½	93½	13-3	—	72½	6'		
'16 ...	31½	58-5	67-7	52½	51-7	33-5	52½	153½	16-10	—	81½	7'		
'17 ...	40½	75-9	83-3	58½	64-10	51-7	71½	186½	25-3	—	104½	10'		
'18 ...	47½	72-9	78-7	46½	59-0	49-3	78½	142½	26-2	—	103	10'		
'19 ...	57	72-10	74-10	46½	75-8	52-3	78½	198½	25-10	—	108	10'		
'20 ...	61½	80-7	92-4	66	90	57-4	90½	242½	41-10	—	125	12'		
'21 ...	36½	72-9	73-9	64½	54-4	34-5	38½	198	18-5	—	115	10'		
'22 ...	34½	47-10	52-11	45½	40-1	29-1	31½	130	14-10	—	88½	8'		
'23 ...	31½	42-2	47-3	39½	33-8	26-8	36	101	14-10	—	79½	7'		
'24 ...	34	49-3	53-9	43½	46-9	27-2	39½	186	16-9	—	82½	7'		
'25 ...	32½	52-2	62-4	50½	42-0	27-2	38½	154	16-0	—	80	7'		
'26 ...	28½	53-3	58-9	49½	36-11	25-1	29½	127	16-3	—	74	6'		
'27 ...	26½	49-3	58-3	44½	42-0	25-4	30½	136	15-11	—	70	6'		
'28 ...	26½	44-8	50-10	40½	39-0	29-0	38½	133	15-0	—	74	6'		
'29 ...	24½	42-2	51-3	38½	35-5	24-7	36½	111	14-3	—	71	6'		
'30 ...	17½	34-3	36-10	33½	28-3	17-2	23	93	13-0	—	73	6'		
'31 ...	14½	24-0	25-1	22½	28-0	17-8	15½	146	9-8	—	67	6'		
'32 ...	17½	25-0	27-5	24½	27-1	19-3	18½	152	9-8	—	65	5'		
'33 ...	18½	22-10	25-7	23½	28-7	15-10	17½	86	7-9	—	61	5'		
'34 ...	21½	20-2	28-0	23½	30-11	17-5	19½	97	7-8	—	58	5'		
'35 ...	29	22-2	31-1	25½	28-7	18-9	17½	107	8-10	—	54	4'		
Average 1904-13	26½	31½	36	30	25½	18½	24½	78	7½	—	51	4'		
1890-99	34	28½	31½	27½	25½	17½	19½	72	6½	—	47	3'		
'78-87	50	40	43½	34½	31½	21	25	102	8	—	55½	4'		
'67-77	58½	54½	56	46	39	26	32½	117	10	—	59	5'		
Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100.														
1873 ...	97-4	108	113	104	104	98	92	137	95	851	110	11		
1915 ...	38-9	99	107	106	96	118	128	80	132	866	122	13		
'16 ...	50-4	107	121	114	132	128	163	131	168	1,064	138	15		
'17 ...	65-8	139	149	127	166	199	221	160	252	1,413	177	20		
'18 ...	76-4	134	140	102	151	190	241	122	262	1,342	174	20		
'19 ...	85-3	134	134	102	194	201	242	170	258	1,435	183	21		
'20 ...	76-1	148	165	143	231	221	279	207	418	1,812	212	25		
'21 ...	48-1	133	132	140	139	132	118	169	184	1,147	195	22		
'22 ...	51-6	88	95	100	103	112	96	111	148	853	150	16		
'23 ...	49-4	77	84	86	86	103	111	86	148	781	134	14		
'24 ...	50-7	90	96	95	120	105	122	159	167	954	139	15		
'25 ...	52-5	96	111	109	108	105	119	132	160	940	136	14		
'26 ...	47-1	98	105	107	95	96	92	109	163	865	125	13		
'27 ...	42-8	90	104	98	108	97	95	116	150	867	119	12		
'28 ...	44-0	82	91	87	100	112	118	114	150	854	125	13		
'29 ...	40-2	77	91	84	91	95	112	95	143	788	120	13		
'30 ...	29-0	63	66	72	72	66	71	79	130	619	124	13		
'31 ...	20-4	44	45	50	71	68	48	125	93	544	114	12		
'32 ...	19-5	46	49	53	69	74	58	130	93	572	110	11		
'33 ...	18-7	42	46	52	73	61	53	74	78	479	103	10		
'34 ...	20-0	37	50	50	79	67	60	83	77	503	98	10		
'35 ...	26-4	41	56	56	73	72	53	91	88	530	92	9		

* The annual prices are the average monthly or weekly quotations, except potatoes, which are the average weekly quotations during the eight months January to April and September to December.

† Not included in the general average.

‡ Meat (9-13), by the carcase, in the London Central Meat Market.

§ La Plata from 1924.

Average Prices of Commodities—Contd.

No of Article	11	12	13	14	15	9-15	16A	16B	17	18A	18B*	18
	Mutton.		Pork.	Bacon.	Lutter.		Sugar.			Coffee.		
Year.	Prime.	Mil- ding.	Lar- ge and Small, average	War- r- ford.	Irish- lan, fine to Inst	Small Total	British West Indian Refining	Beet, German, Sy p. r. foli	Java, Lombok, Mol- dhu, r	Java Plant- ation, Low Mol- dhu, r	Rio, Good.	Mean of 18A and 18B.
	d. per s lbs.	d. per s lbs.	d. per s lbs.	s per cwt	s per cwt		s. per cwt	s. per cwt.	s. per cwt	s. per cwt	s. per cwt	
1873 ...	71	63	54	81	123	—	22½	25	28	100	86	—
1915 ...	75½	69½	72	93½	141	—	14½	17½	19½	78½	43½	—
'16 ...	93½	86½	87½	109½	191	—	24½	22½	26½	77½	50	—
'17 ...	114	109	110½	148	216	—	31½	23½	32	94½	58	—
'18 ...	109	109	128½	183	247	—	33	26½	35½	128	69	—
'19 ...	114	114	128	190	252	—	35	34½	43½	145½	114½	—
'20 ...	144½	144½	168½	239½	301	—	58	65½	74½	148	111½	—
'21 ...	130½	125½	121½	179	250	—	19½	18½	22	120½	63	—
'22 ...	125	121½	101	145½	202½	—	15	14½	15	120½	74½	—
'23 ...	114½	107½	89	113½	186	—	23½	23½	24½	117½	55	—
'24 ...	111½	103½	70	106	211	—	23½	20½	21½	152½	85½	—
'25 ...	106½	98½	84½	128½	206½	—	16½	11	12½	153½	98½	—
'26 ...	89	80½	98½	130	173	—	16½	11½	12½	154½	89½	—
'27 ...	86	79	85	102½	178	—	16½	12½	13½	143½	71½	—
'28 ...	92½	87	77	101½	185½	—	13½	10½	11½	143	81½	—
'29 ...	89½	83	91	116½	180½	—	11½	8½	8½	141½	74½	—
'30 ...	92	86	89	105½	146½	—	8½	5	6½	106	42½	—
'31 ...	79	73	65	83½	130	—	7½	5½	6½	101½	33½	—
'32 ...	63	55	54	77	126½	—	7½	5½	5	105	54½	—
'33 ...	69	63	60	81½	105½	—	7	4	5½	86	42½	—
'34 ...	74	70	65	90	79	—	6	4	4½	87	42½	—
'35 ...	75	70	62	89	92½	—	6½	3½	4½	67½	29½	—
Average												
1904-13	58½	51½	47½	67	113	—	10½	10½	12	75½	43½	—
1890-99	54½	41½	42½	59	100	—	11½	11½	13½	95	62	—
'78-87	64½	53	49	71	116	—	17	18	21½	78	52	—
'67-77	63	55	52	74	125	—	23	24	28½	87	64	—

Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100

	113	114	104	109	98	760	101	98	115	134	125
1873 ...	113	114	104	109	98	760	101	98	115	134	125
1915 ...	119	127	138	126	113	881	67	66	90	68	79
'16 ...	148	157	169	148	133	1,067	100	93	90	78	84
'17 ...	182	199	212	200	173	1,345	121	115	109	91	100
'18 ...	174	199	248	247	198	1,447	127	125	148	110	129
'19 ...	181	207	246	258	202	1,493	155	153	167	180	174
'20 ...	230	263	324	324	241	1,844	263	262	170	174	172
'21 ...	208	228	234	242	200	1,527	81	77	140	98	119
'22 ...	199	221	194	196	162	1,286	62	54	140	116	128
'23 ...	182	196	171	154	149	1,135	104	87	135	86	111
'24 ...	177	188	135	143	169	1,103	93	75	175	133	154
'25 ...	169	180	162	174	165	1,133	60	43	176	154	165
'26 ...	141	146	190	176	138	1,050	60	44	178	139	159
'27 ...	136	145	163	138	142	967	62	47	165	112	139
'28 ...	146	158	148	137	149	996	51	40	165	127	146
'29 ...	142	151	175	157	144	1,021	42	31	162	117	140
'30 ...	146	155	171	143	117	992	31	22	123	66	95
'31 ...	125	133	123	113	104	836	29	23	120	53	87
'32 ...	100	100	104	104	101	737	27	20	121	85	103
'33 ...	110	114	115	110	84	740	25	18	100	66	83
'34 ...	117	127	125	122	64	757	22	16	100	67	84
'35 ...	119	127	119	120	74	749	21	17	78	46	62

* Index numbers not included in general average.

† East India good middling from 1908.

‡ Comparative values.

§ White Java, C.I.F., from 1924.

Average Prices of Commodities—Contd.

No. of Article.	19A	19C	19B	19	16-19	1-19	20A	20B	21	22	—	23
	Tea.				Sugar, Coffee, and Tea. Total.	Food. Total.	Iron.			Copper.		Tin.
Year.	Conzou, Common.	Inlian, Good Medium.	Average Import Price.	Mean of 19A and 19B.			Scottish Pig.	Cleveland (Mid- dies- brough) Pig.	Bars, Com- mon.	Stand- ard.	English Tough Cake.	Strait.
	d. per lb.	d. per lb.	d. per lb.				s. and d. per ton.	s. and d. per ton.	£ per ton.	£ per ton.	£ per ton.	£ per ton.
1873 ...	12	—	16-67	—	—	—	117-3	—	12½	84	92	132
1915 ...	8½	10½	11-01	—	—	—	71-2	65-2	10½	72½	82½	164
'16 ...	8	10½	11-20	—	—	—	90-0	84-0	13½	115½	134	182
'17 ...	16½	15½	14-68†	—	—	—	95-7	89-7	13½	124½	136½	238
'18 ...	20½	16	15-0	—	—	—	101-0	95-0	14	115½	126	331
'19 ...	13½	15	15-5	—	—	—	143-1	137-1	19½	92	90½	257
'20 ...	11½†	9½	14-97	—	—	—	214-11	208-11	28½	97½	112½	302
'21 ...	4½	7	12-4	—	—	—	168-6	137-4	19½	69½	72½	171
'22 ...	8½	13½	14-9	—	—	—	99-10	90-7	11½	63½	66½	162
'23 ...	11	17½	17-58	—	—	—	108-0	108-9	11½	65½	69½	206
'24 ...	9½	17½	19-0	—	—	—	96-8	88-2	12½	63½	67½	251
'25 ...	7½	14½	18-34	—	—	—	83-4	72-8	11½	61½	65½	267
'26 ...	7½	16½	18-82	—	—	—	87-2	87-6	11½	58½	63½	297½
'27 ...	6½	14½	18-58	—	—	—	80-5	73-0	11½	55½	60½	303½
'28 ...	6½	12½	16-84	—	—	—	69-9	65-9	9½	63½	66½	229½
'29 ...	6½	11½	16-11	—	—	—	74-0	70-3	9½	75½	78½	207½
'30 ...	5½	9½	15-12	—	—	—	76-0	67-0	9½	54½	58½	144½
'31 ...	4½	6½	13-29	—	—	—	71-0	58-6	10½	38½	39½	121½
'32 ...	4½	5½	10-75	—	—	—	68-2	58-6	10½	31½	33½	140
'33 ...	6½	8½	11-87	—	—	—	66	62-3	9½	32½	34½	202½
'34 ...	8½	12	13-20	—	—	—	69-6	66-11	9½	30½	32½	232½
'35 ...	6½	10½	13-06	—	—	—	70-6	67-10	9½	32½	34½	230½
Average												
1904-13	7½	7½	8½	—	—	—	57½	51½	6½	67½	72	164½
1890-99	4½	7½	9½	—	—	—	47	41½	5½	50	53	81
'78-87	6½	—	12½	—	—	—	46	38	5½	55	60	89
'67-77	11½	—	17½	—	—	—	69	60	8½	75	81	105

Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100.

	1873	1915	'16	'17	'18	'19	'20	'21	'22	'23	'24	'25	'26	'27	'28	'29	'30	'31	'32	'33	'34	'35
...	107	74	71	150	186	120	100	39	77	98	82	70	69	60	56	54	46	42	38	58	77	60
...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
...	97	64	65	85	87	90	88	72	86	102	110	106	109	108	98	93	88	78	62	68	77	76
...	102	69	68	117	137	105	94	53	82	100	96	88	89	84	77	74	67	60	50	63	67	68
...	426	281	345	453	518	587	791	332	326	402	418	356	352	332	314	287	215	199	200	189	199	168
...	2,037	2,028	2,476	3,211	3,307	3,515	4,447	3,006	2,465	2,318	2,475	2,429	2,267	2,166	2,164	2,096	1,826	1,579	1,509	1,408	1,459	1,447
...	170	106	135	144	152	217	329	237	148	168	143	121	135	119	105	112	111	100	98	99	106	107
...	—	128	166	166	170	234	343	232	136	144	152	144	139	136	120	118	121	123	121	117	116	117
...	152	97	154	166	154	123	130	92	84	88	84	82	77	74	85	101	73	52	43	44	40	43
...	112	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
...	126	156	173	227	315	245	288	163	154	196	239	254	283	289	219	198	138	115	131	193	221	219

* Index numbers not included in the general average.

† Approximate.

‡ Nominal.

Average Prices of Commodities—Contd.

Year.	24 Lead.	25A Wallsend Hetton in London	25B Coal. New- castle Steam.	26 Average Export Price.	20-26 Mime- rals. Total	27 Mid- dling Ameri- can d.	28 Fair Dhol- lerah.] d. per lb	29A Petro- grad "	29B Russian Average Import Price.	30A Manila Fair Roping	30B Petro- grad Cuen, (a)	31 Good Me- dium ++
	English Fig. £ per ton.	£ s. per ton.	£ s. per ton.	£ s. per ton.		per lb.	d. per lb	£ per ton.	£ per ton.	£ per ton.	£ per ton.	£ per ton.
73 ...	23½	32	—	20-90	—	9	6½	47½	44	43	36	18
15 ...	24	30½*	21½	16-96	—	5-87	4½	59½	66½	41½	60½	21½
16 ...	32½	27½*	41½	24-64	—	9-00	7	76½	85½	54½	71	31
17 ...	32½	27½*	30	27-16	—	16-55	13½	113½	151½†	84½	105½	39½
18 ...	32½	33-6	33½	30-6	—	22-3	17½	120½	156½	99½	166½	39½
19 ...	29½	45-3	45½	46-2	—	19-65	14½	120½	174½	58½	147½	50½
20 ...	40	32	51½	79-8	—	23-14	13½	120½	345½	65	145½	44½
21 ...	24½	32½	29	34-83	—	9-4	5½	112½	118½	40½	145½	27½
22 ...	25½	34½	24½	24-16	—	12-10	8	95	84½	33½	57½	30½
23 ...	28½½	32½	28	25-13	—	15-25	10	83½	84½	33½	57	26
24 ...	35½	27½	22½	23-38	—	16-26	11-03	120	104½	44	81	31½
25 ...	37½	29½	16½	20-08	—	12-64	11-01	92½	120½	46½	89½	49½
26 ...	32½	**30½	**16½	18-59	—	9-40	7-75	65	72½	43	74½	43½
27 ...	25½	23½	14½	17-80	—	9-54	8-27	95½	74½	43½	66½	32½
28 ...	22½	21½	13½	15-67	—	10-92	8-66	98½	91½	37½	63½	33½
29 ...	24½	23½	15½	16-13	—	10-26	7-73	76½	71	37	61	32
30 ...	19½	24½	14½	16-64	—	7-49	5-12	53½	60½	26½	48	20
31 ...	14½	24½	13½	15-98	—	5-90	4-60	36	35½	18½	27½	15½
32 ...	13½	23½	13	16-27	—	5-24	4-83	45	42	18	36	16
33 ...	13½	22½	13½	16-08	—	5-54	4-53	51½	46½	15½	37	14½
34 ...	12½	20½	14	16-08	—	6-70	4-80	60½	50½	14½	42½	14½
35 ...	16	20½	14½	16-30	—	6-71	5-42	79½	72½	19½	43½	16½
verage	15½	18½	11½	11½	—	6½	5	32½	36½	30½	31½	18½
04-13	12	17½	10½	10½	—	4½	3	27	27	26½	25	12½
90-99	14	16½	8½	9	—	6	4½	33	34	35½	26½	15
78-87	20½	22	12½	12½	—	9	6½	46	48	43	35	19

Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100.

Year	24	25A	25B	26	20-26	27	28	29A	29B	30A	30B	31
73 ...	117	145	—	167	989	100	92	97	—	101	—	95
15 ...	117	140	—	136	880	65	64	134	—	130	—	111
16 ...	159	125	—	197	1,109	100	104	172	—	161	—	163
17 ...	158	125	—	217	1,203	183	201	282	—	243	—	207
18 ...	158	153	—	245	1,347	248	253	294	—	341	—	207
19 ...	143	206	—	370	1,538	218	219	313	—	264	—	264
20 ...	195	145	—	638	2,068	257	203	495	—	270	—	236
21 ...	118	147	—	279	1,268	104	86	246	—	237	—	145
22 ...	123	156	—	193	994	134	118	191	—	116	—	162
23 ...	139	147	—	201	1,083	169	148	179	—	116	—	137
24 ...	175	125	—	187	1,105	181	163	239	—	160	—	167
25 ...	183	135	—	161	1,080	140	163	227	—	174	—	261
26 ...	157	138	—	149	1,078	104	115	147	—	151	—	231
27 ...	125	105	—	142	990	106	123	181	—	141	—	172
28 ...	109	97	—	125	860	121	128	203	—	130	—	178
29 ...	117	106	—	129	881	114	114	157	—	126	—	168
30 ...	95	113	—	133	784	83	76	121	—	96	—	105
31 ...	71	112	—	127	700	66	68	76	—	58	—	84
32 ...	65	106	—	130	694	58	72	93	—	70	—	85
33 ...	65	103	—	129	750	62	67	106	—	68	—	78
34 ...	61	92	—	129	765	74	71	119	—	73	—	74
35 ...	78	92	—	130	786	74	80	161	—	80	—	89

* Approximate prices.

† Approximate.

‡ Nominal.

§ Best Yorkshire house after 1916.

" New No. 1 Omra, Fme.

¶ Livonian Z.K. from 1921.

** Average price January-April, 1926.

++ Lightnings from 1931.

(a) Russian Surety Group 1, Sort 1 from 1931-33; Jugo-Slav Peasant from 1934.

Average Prices of Commodities—Contd.

No. of Article	32A	32B	33	34	27-34	35A	35B	35C	36A	36B	37
	Wool.			Silk.		Hides.			Leather.		Tallow.
Year.	Merino, Port Phillip, Average Fleeced, d. per lb.	Merino, Adelaide, Average Greasy, d. per lb.	English, Lincoln Half Hogs, d. per lb.	Tsatlee, † s. per lb.	Textiles, Total.	River Plate, Dry, d. per lb.	River Plate, Salted, d. per lb.	Average Import Price, d. per lb.	Dressing Hides, d. per lb.	Average Import Price, d. per lb.	Town, s. per cwt.
1873 ...	25	11½	24½	21½	—	11	8½	—	18½	—	44
1915 ...	21½	10½	17½	9½	—	13	11	10-04	28½	21½	36½
'16 ...	32½	16½	20	16½	—	14½	13½	11-70	28½	27	46½
'17 ...	46½	23½	20½	21½	—	20	16	15-52	35	34½	62½
'18 ...	47½	23½	18½	25½	—	20½	13½	15-9	32½	32½	81½
'19 ...	67	32½	22½	26	—	22½	19½	17-1	36½	40½	87½
'20 ...	79½	32	22	38½	—	20½	18½	20-1	43½	71½	75
'21 ...	31½	11½	8½	26½	—	9½	8½	9-58	25½	46½	36½
'22 ...	39	17	9½	28½	—	9½	8½	8-06	24½	36	34½
'23 ...	43½	20½	12	24½	—	9½	8½	8-23	23½	31½	36½
'24 ...	53½	25½	18½	23½	—	10½	8½	8-63	22½	33½	42½
'25 ...	41½	17½	17½	18½	—	11½	8½	9-87	23	33	42½
'26 ...	36½	16½	15	15½	—	10½	8	9-32	21½	35½	38½
'27 ...	38½	17½	15½	15½	—	12½	10½	9-85	22½	36½	33½
'28 ...	37	17½	14	—	—	15½	11½	12-09	23½	37½	36½
'29 ...	35½	13½	16½	13½	—	10½	8½	10-80	19½	38½	36½
'30 ...	18½	8½	10½	10½	—	6½	6½	7-80	18½	33½	28½
'31 ...	14-7	7-1	8½	8½	—	5½	5½	6-12	17½	32½	19½
'32 ...	15-0	7-2	5½	8½	—	4½	4½	5-47	17½	28½	21½
'33 ...	19-9	9-3	5½	6½	—	5½	4½	5-65	17½	26½	19½
'34 ...	21½	10-4	7	5½	—	4½	4½	5-71	17½	25½	17½
'35 ...	20-1	9-5	7½	5½	—	5½	5½	5-51	17½	25½	24½
Average 1904-13	17½	9	10½	11½	—	9½	7½	6½	16	17	31½
1890-99	13½	6½	10½	11½	—	6½	5½	5	13½	13½	25
'78-87	18½	8½	11½	15	—	8½	6½	6½	15	17	35½
'67-77	21½	9½	19½	23	—	9	7	6½	16	18½	45
Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100.											
1873 ...	118	—	124	95	322	120	—	—	114	—	97
1915 ...	104	—	88	43	739	149	—	—	145	—	81
'16 ...	159	—	101	71	1,031	174	—	—	160	—	104
'17 ...	219	—	106	94	1,535	225	—	—	200	—	139
'18 ...	222	—	95	112	1,772	218	—	—	188	—	182
'19 ...	315	—	114	113	1,820	258	—	—	222	—	195
'20 ...	359	—	111	168	2,099	257	—	—	330	—	167
'21 ...	140	—	44	115	1,117	123	—	—	205	—	81
'22 ...	180	—	49	125	1,075	114	—	—	174	—	77
'23 ...	206	—	61	105	1,121	113	—	—	153	—	81
'24 ...	254	—	96	102	1,362	119	—	—	163	—	94
'25 ...	188	—	87	79	1,319	132	—	—	161	—	94
'26 ...	170	—	76	69	1,063	121	—	—	164	—	85
'27 ...	177	—	78	67	1,045	142	—	—	172	—	75
'28 ...	174	—	91	61	1,086	172	—	—	176	—	82
'29 ...	156	—	81	60	976	129	—	—	166	—	81
'30 ...	86	—	54	48	669	92	—	—	150	—	64
'31 ...	70	—	43	39	504	77	—	—	146	—	43
'32 ...	71	—	29	35	513	66	—	—	132	—	47
'33 ...	94	—	30	29	534	68	—	—	127	—	44
'34 ...	102	—	35	24	572	67	—	—	123	—	39
'35 ...	96	—	37	24	641	69	—	—	125	—	55

* Port Phillip fleece washed nominal since 1895, exactly in proportion with the value of clean wool.

† Common New Style from 1921.

Average Prices of Commodities—Contd.

No. of Article	38		39	40A	40B	41	42	43	44	45A	45B	45—45	20—45	1—45
	Oil.				Seeds.	Petro- leum.	Soda.				Timber.			
Year.	Palm.	Olive.	Lin- seed.	Lin- seed.	Ro- fined.	Crystals.	Nitrate of Soda.	Indigo.	Benzal, Good Consuming.	Hewn, Average Import Price.	Sawn or Split, Average Import Price.	Sundry Materials.	Materials.	Grand Total.
	£ per ton.	£ per ton.	£ per ton.	s. per qr.	d. per gall.	s. per ton.	s. per cwt.	s. per lb.	s. per load.	s. per load.	s. per load.	Total.	Total.	
873 ...	38	43	32	62	15½	100	15½	6½	65	62	—	—	—	
915 ...	34½	51½	30½	57½	8½	48½	12½	13½	58½	94½	—	—	—	
'16 ...	44½	59½	41½	80½	12	78½	17½	13½	82½	148½	—	—	—	
'17 ...	46	115½	56½	112½	16½	89½	25	10½	97	210	—	—	—	
'18 ...	44½	198½	63½	131½	21½	82½	27½	9	107½	271	—	—	—	
'19 ...	69½	200½	92½	139½	17½	118½	24½	9½	137½	232½	—	—	—	
'20 ...	69½	200½	88½	157	25½	150½	24½	14½	119	261½	—	—	—	
'21 ...	36½	80½	31½	72½	22½	140	18½	11½	68½	156½	—	—	—	
'22 ...	34½	75½	39½	75½	15½	123	14½	9½	46½	117½	—	—	—	
'23 ...	36½	66½	42½	77½	13	103	13½	7½	48	131½	—	—	—	
'24 ...	40½	79½	42½	81½	13½	101½	13½	6½	49½	122	—	—	—	
'25 ...	40½	73½	43½	80½	13½	100	13½	5½	47½	122½	—	—	—	
'26 ...	37½	79½	32½	63½	13	100	13½	5½	48½	107	—	—	—	
'27 ...	34½	102½	31½	64½	13	100	12½	5½	45½	107½	—	—	—	
'28 ...	35½	80½	29½	66½	11½	100	10½	5½	45½	111½	—	—	—	
'29 ...	34½	72	35½	74½	12½	100	10½	5½	44½	107½	—	—	—	
'30 ...	25½	52½	36½	61½	12½	100	9½	5½	44½	102½	—	—	—	
'31 ...	19½	53½	18½	38½	11½	100	9½	5½	37½	83½	—	—	—	
'32 ...	17½	57½	17	38½	10½	100	8½	5½	35½	75½	—	—	—	
'33 ...	15½	53½	20½	39½	10½	100	8½	5½	31½	75½	—	—	—	
'34 ...	13½	62½	21½	42½	10½	100	7½	5½	31½	79½	—	—	—	
'35 ...	19½	61½	24½	43½	10½	100	7½	5½	32½	73½	—	—	—	
Average														
1904-13	31½	43½	26½	49½	6½	60	10½	3	38	56	—	—	—	
1890-99	24½	35	19½	38	5½	53	8½	4½	40	45	—	—	—	
'78-87	32½	40	23	46	6½	62	12½	6	47	47	—	—	—	
'67-77	39	50	30	60	12½*	92	14	7½	60	54	—	—	—	
Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100.														
1873 ...	97	86	105	122	109	110	92	111	1,163	2,974	5,011			
1915 ...	89	104	97	71	53	90	184	134	1,197	2,816	4,844			
'16 ...	114	119	135	96	86	128	183	202	1,501	3,641	6,117			
'17 ...	118	231	187	129	98	178	142	270	1,917	4,655	7,866			
'18 ...	115	396	216	170	90	194	124	332	2,225	5,344	8,651			
'19 ...	178	400	258	138	128	177	126	325	2,405	5,763	9,278			
'20 ...	179	400	272	203	164	177	200	335	2,684	6,851	11,298			
'21 ...	95	160	116	177	152	135	158	198	1,600	3,985	6,991			
'22 ...	89	151	127	122	134	102	128	143	1,361	3,430	5,895			
'23 ...	93	133	134	104	112	96	103	157	1,234	3,488	5,806			
'24 ...	103	160	138	105	111	97	84	151	1,325	3,792	6,267			
'25 ...	104	147	137	105	109	96	79	150	1,314	3,713	6,142			
'26 ...	96	159	106	104	109	95	78	137	1,254	3,395	5,662			
'27 ...	88	205	107	104	109	90	76	134	1,302	3,337	5,503			
'28 ...	92	161	108	94	109	78	76	138	1,286	3,232	5,396			
'29 ...	89	144	122	102	109	73	76	134	1,225	3,082	5,178			
'30 ...	65	104	110	102	109	70	76	129	1,071	2,524	4,350			
'31 ...	51	108	63	90	109	65	76	106	934	2,138	3,717			
'32 ...	45	114	61	84	109	62	76	97	893	2,100	3,609			
'33 ...	40	108	67	82	109	60	76	94	875	2,159	3,567			
'34 ...	35	124	71	80	109	56	76	97	877	2,214	3,673			
'35 ...	50	123	75	84	109	54	76	92	912	2,339	3,786			

* Petroleum average, 1873-77.

† Nominal.

MISCELLANEA.

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MEMORIAL ON EARNINGS AND COST OF LIVING.

Addressed to the MINISTER OF LABOUR by the PRESIDENT AND COUNCIL OF THE ROYAL STATISTICAL SOCIETY, ON 5 FEBRUARY, 1936.

This Memorial was formally acknowledged on February 6th. Fellows will have observed that the Minister has announced his intention of collecting the information necessary for reconstructing the index of working-class cost of living and has appointed a committee of 14 to advise him on the subject. Of these the following are Fellows of the Society: Professor Bowley, C. T. Houghton, D. Caradog Jones, and E. C. Ramsbottom.]

TO THE MINISTER OF LABOUR:

Sir,

The President and Council of the Royal Statistical Society desire to draw your attention to the unsatisfactory character of the information relating to wages and retail prices in the United Kingdom, and to the urgent necessity for undertaking immediately enquiries designed to fill up the existing gaps in our knowledge.

I. EARNINGS.

2. The Earnings and Hours Enquiry of 1906 was the last comprehensive investigation of the earnings and wages of persons engaged in different occupations and industries, and, being on a voluntary basis, it was incomplete in different degrees in its various sections. The subsequent enquiries into average weekly earnings and the amount of the wage-bill of the United Kingdom, also taken on a voluntary basis coincidently with the recent Censuses of Production, have been much more limited in their scope. In particular they do not show the numbers of workers in different earnings-groups, and this is, perhaps, the greatest deficiency in our wage statistics.

3. For regular information there are available the particulars

of time, rates of wages in certain industries, changes in time and piece rates of wages, and amounts of wages paid by reporting firms in a few important industries, all of which are collected by the Ministry of Labour. The Ministry of Transport and the Mines Department also collect and publish information as to wages on railways and in mines. From these data a valuable index of the movement of wage-rates has been compounded by Mr. Ramsbottom of the Ministry of Labour (*Journal of the Royal Statistical Society*, 1935, Part IV), but they do not enable any reliable estimates to be made of the distribution of actual earnings of the working-classes and the numbers of persons earning specific amounts in particular industries and occupations. It is quite unnecessary to stress the high sociological importance of exact information as to the share of the National Income secured by different classes of the community, and especially by the working-classes, or as to the proportions in which the shares of the several classes or industries may be changing. The need for development of social policy can only be effectively determined when we have a datum line from which changes can be measured.

4. We do not conceive it to be our function to draw up detailed plans for public enquiries, for that can be done far more efficiently by the officials of the Public Departments concerned, but there are a few broad suggestions which we desire to make. In the first place, we suggest that an Enquiry into Earnings should take the same form as that of 1906, with modifications which experience may have shown to be desirable. We would, however, urge (a) that it should be compulsory and taken as soon as possible, (b) that it should cover at least the same industries as the Census of Production, and (c) that after the first such enquiry it should be held regularly at the same time as the Census of Production. We favour the extension of the Enquiry to transport and to agriculture, but the manner in which this should be done would, perhaps, be a matter for consultation with the Ministry of Agriculture and Fisheries, the Ministry of Transport, and the Scottish Office.

Special enquiries into the wages of clerical workers, of workers in the distributive trades, both wholesale and retail, and workers in the various personal services are also urgently required, as the lack of information is very great.

II. COST OF LIVING.

5. The Ministry of Labour Index of Retail Price Movements is the only instrument by which changes in the cost of living of the working-classes can be estimated and by which (coupled with the fragmentary information available for money wages) the material progress of that class can be surmised. Furthermore, on the basis

of changes in this index, periodical alterations are made in the rates of wages of a large number of workpeople. The substantial accuracy of this index is, therefore, plainly a matter of the highest importance. Yet its basis consists, mainly, of some 1900 working-class family budgets collected by the Board of Trade as long ago as 1904. It is widely, and justly, held that the applicability of the index to-day is seriously invalidated by both the age and the paucity of the data on which it is based. The constitution of the average family is different from what it was before the War, both in size and in the age distribution of its members; the relative importance of various classes of family expenditure is different to-day from what it was in pre-war days; and, as the level of income has risen, many things are now regarded as necessities or comforts which previously were considered as luxuries. We submit, therefore, that the case for a re-examination of the "cost of living index number" is irrefragable.

6. Family budgets, from which must be provided the material utilized for the calculations of the cost of living index, can, when classified and analysed according to the family income of the persons furnishing the budgets, supply information regarding expenditure, particularly on food, at different income levels. While the standard of living has undoubtedly risen over the whole population, local enquiries during recent years in a number of towns in Great Britain suggest that a section of the population suffers from malnutrition. We do not need to labour the importance of ascertaining reliable information as to the probable extent of this class of persons.

7. In view of the foregoing considerations we submit that there is urgent need for undertaking at an early date extensive enquiries into earnings and cost of living. Probably, as a practical measure, it may be necessary to confine these enquiries to what is loosely termed the "working-classes," *i.e.* persons engaged in manual labour in agriculture, fishing, mining, manufacturing, and transport. We would point out, however, that there is a strong case for including also the "black-coated workers"—persons engaged in clerical and other work in commercial and financial occupations and persons engaged in distributive trades or in services—and we would suggest that consideration should be given to the desirability of compiling separate indices for those classes.

8. It is imperative, in our opinion, that the Cost of Living Enquiry should be applied to all important industries and to all types of area, both industrial and rural; all bias from the overrepresentation of particular industries or areas should be carefully excluded. This can be done more readily now than in 1904. We assume that the enquiry schedule would cover family constitution (by age and sex), a detailed food schedule (prepared in co-operation

with the Ministry of Health), particulars of other important classes of expenditure, such as rent, fuel and lighting, clothing (including repairs), household sundries, clubs, insurance, savings, amusements, travelling, and, perhaps, particulars as to family income (including earnings of wage-earners, pensions, insurance, etc.). We would urge that the details as to quantity and cost of food should cover four weeks, either consecutively, or at different seasons of the year, and that particulars as to clothing and other expenses, which recur at less frequent intervals, should be given for a period of a year.

9. As we have already indicated, the Enquiry should be comprehensive and free from bias. Comprehensiveness implies a large number of family budgets; the aim should be to secure not fewer than 25,000. In the past, only a comparatively small number of budgets has been obtained in any enquiry, partly because the persons applied to did not possess the information, and partly because they were indifferent to or ignorant of the importance of the enquiry. We believe that the only practical way of securing a satisfactory number of budgets is to offer a small fee for each budget. It would also be made easier for the local representatives of the Ministry to secure the completion of imperfect returns. Incidentally, it would probably be necessary for the Ministry, in view of the amount of work involved, to obtain the voluntary co-operation of bodies such as trade unions, Women's Institutes in rural areas, etc.

10. It is necessary, not only that the Enquiry should be unbiassed, but also that it should be demonstrably free from any tendentiousness. For that reason, we suggest the appointment of a non-official committee to assist the Ministry in the framing of the schedules and the organization and conduct of the investigation. Such a committee might consist of representatives (including women) of trade unions, of manufacturers, of retail traders, of the co-operative movement, of economics, of statistics, and perhaps, of other interests.

11. We forbear from touching on such questions as a separate enquiry for Scotland or the remission of the agricultural enquiry to the Ministry of Agriculture and Fisheries. We trust that the Ministry is as convinced as we are of the importance of the suggested enquiries and as anxious as we are to see them carried out, and in that belief we urge our proposals and assure the Ministry of our cordial support. We confidently rely, therefore, on receiving from you a favourable reply to our petition.

*For the President and Council of the
Royal Statistical Society.*

February 5, 1936.

(signed) HENRY W. MACROSTY
Joint Honorary Secretary.

THE NEW SURVEY OF LONDON LIFE AND LABOUR.
EFFECT OF MODIFYING THE POVERTY LINE.

By A. L. BOWLEY.

THE *New Survey of London Life and Labour* was designed to serve two purposes: to afford a comparison with Booth's *Life and Labour*, and to provide material for similar comparisons at some later date. For the first purpose it was necessary to keep as strictly as possible to Booth's methods and definitions, and in Volume III a careful assessment of his Poverty Line at the prices of the year 1929 was made. But the opinion as to what constitutes poverty has changed in fifty years, and it is desirable to draw up a new definition for future use. To do this from the material collected for the Survey and give any resulting measurement was found to be impracticable in the absence of Budgets of expenditure and of any accepted definition. If any new estimate of a reasonable minimum of expenditure for each type of family group is worked out at the London prices of 1929, it will be quite possible to apply it to the sample containing about 28,000 cards of family income that is preserved at the London School of Economics.

The object of the present note is more modest; it is to find the effect of raising the minimum food expenditure of children under 14 years to that considered adequate from recent dietetic studies. In brief, the amount of milk is raised from about $2\frac{1}{2}$ pints to 7 pints weekly and the allowance for fresh fruit and vegetables is increased. To effect the modification the food minimum was increased from 28*d.* to 40*d.* weekly for children under three years old, from 28*d.* to 51*d.* for the ages three to five, and from 42*d.* to 67*d.* from five to fourteen years. No other changes were made.

The possible diet under the minimum used in the *Survey* can be studied in Volume III, pp. 74-77, and Appendix II. The difference between the old and the new may be illustrated by one example:—

Weekly diet for Age 4.

				Old Basis.		New Basis.	
				Quantity.	Pence.	Quantity.	
Milk	...	...	...	$2\frac{1}{2}$ pints	$7\frac{1}{2}$	7 pints	22
Cheese	...	...	...	—	—	10 oz.	$8\frac{1}{2}$
Bread and flour	...	...	...	5 lb.	$10\frac{1}{2}$	2 lb.	$4\frac{1}{2}$
Margarine	...	...	...	8 oz.	3	7 oz.	$2\frac{1}{2}$
Sugar, etc.	...	...	...	10 oz.	$3\frac{1}{2}$	14 oz.	$4\frac{1}{2}$
Potatoes	...	...	...	16 oz.	$1\frac{1}{4}$	28 oz.	2
Fruit and vegetables	...	...	...	—	2	—	7
Total	...	...	...		28		51

The prices are those in London in 1929, which were higher in some cases than those ruling now, so that the 51d. would be replaced by about 46d. at modern prices. Both diets include the calories and protein believed to be needed, but the later one replaces a bread diet largely by milk and cheese, and allows for the vitamins most readily obtained from fresh fruit and vegetables.

Before the investigation was made an estimate was set out of the needs at each year of age on one of the bases of the study made in the *Week-End Review* in March, 1934, which serves the purpose sufficiently. In it the amount of milk is reduced and that of other foods increased gradually from the age five to fifteen. But to save labour when only an approximate result was in any case possible, only three age-groups were separated, as named above, the average addition for the years in each group being used.

The basis being settled, the 28,000 cards of the *Survey* were turned through, and every case where the addition transferred a family from above to below the Poverty Line was recorded. In all 415 families were affected. The income taken was that when all working members of the household were credited with full-time work, and all the earnings, etc., of different members of a family were supposed to be pooled, if necessary, for common use. In assembling the results, the figures for each of the thirty-eight Boroughs were weighted as in the estimates in the *Survey*, but practically the same results come from the unweighted figures.

Working-Class Families. Percentage below Poverty Line. London Survey Area, 1929-30.

				Full-Time Earnings.			Week of Investigation.
				Old Basis.	Additions.	Total.	Old Basis.
Families	...	...	...	5.7	1.6	7.3	9.8
Persons :							
Males over 14	...	...	...	2.5	1.4	3.9	6½
Females over 14	...	...	...	5.0	1.4	6.4	8½
Children 5-14	...	...	...	7	6½	13½	13
" 3-5	...	...	...	5½	6½	12	13
" 0-3	...	...	...	5½	5½	11	13
All	...	...	...	4.6	2.7	7.3	9.1

The last column is given only for reference, for the effect of the raised minimum has not been ascertained when income was lost from want of work or from illness. The intention was rather to find the position when full wages were received—that is, the adequacy of wages and other regular income to meet the raised requirements.

Of course the main effect is found in the larger families, and the

additions are much greater for children than for adults. When a family is below the line, it is, of course, assumed that every member is below it.

The main result of the investigation is to show that, if we allow this more liberal minimum for children, the percentage of them that live in families in poverty is doubled, and averages about 12 per cent. of all working-class children. That is, for about one child in eight the family income * is insufficient to afford the diet with minimum expenditure on all objects. It is not, of course, to be supposed that if the income was raised the addition would be devoted to buying more milk and fruit; other objects of expenditure, especially at these low incomes, would be thought to have greater claims.

It may be added that the average deficit of these additional families was about 3s. 8d. The quartiles were 1s. 1d. and 5s. 6d., the lowest and highest deciles 6d. and 7s. 9d. Before the addition to the needs, the average excess was also about 3s. 8d., the quartiles and deciles also being nearly the same.

In the Table in Volume VI, p. 110, last column, of the *New Survey*, the effect of the modification is to add 1·6 per cent. to the families below the line, and to subtract 1·1 and 0·5 from the percentages 0 to 5s. and 5s. to 10s. above the line respectively.

* Free milk at school and help from charitable or public sources are not included in income.

THE PRECISION OF INDEX NUMBERS—II.

By E. C. RHODES.

In the *Journal of the Royal Statistical Society* (1936, Part I, pp. 142-46), a method of estimating the precision of Index numbers was given. If I_t stands for the number which is the subject of estimation at a particular time (t), and if X_t , Y_t , Z_t , etc., represent the indices calculated for different authorities, we assume that

$$X_t = r_a I_t + A_t, Y_t = r_b I_t + B_t, \text{ etc.}$$

From a series of values of the computed indices over a period of time we obtain averages and deviations from these averages, and have equations of this nature :

$$x_t = r_a i_t + a_t, y_t = r_b i_t + b_t, \text{ etc.,}$$

where $x, y \dots i, a, b \dots$ represent deviations from averages.

We obtain the approximate relations

$$R_a R_b = S(x_t y_t), R_a R_c = S(x_t z_t), \text{ etc.,}$$

on the assumption that there was no correlation between the i 's, the a 's, the b 's, etc.

We are then able to estimate the degree of precision in the index numbers.

As an illustration, the method was applied to the monthly Wholesale Price Indices of (a) the Board of Trade, (b) the *Statist*, (c) *The Times* newspaper, (d) the *Economist*, for the period 1931-34.

The results were given in the paper referred to above.

Later, when the correlations between the computed i 's, a 's, b 's, etc., were calculated, it was found that actually there was quite a high negative correlation (-0.7) between the a 's and the d 's, though the other correlations were not sensible. If we assume a correlation r_{ad} between a and d , the formula given on p. 145 *loc. cit.* becomes

$$\frac{i_t}{\sqrt{S(i_t^2)}} = \frac{\frac{y_t R_b}{S(b_t^2)} + \frac{z_t R_c}{S(c_t^2)} + \frac{1}{1 - r_{ad}^2} \left\{ \frac{x_t}{\sqrt{S(a_t^2)}} \left(\frac{R_a}{\sqrt{S(a_t^2)}} - r_{ad} \frac{R_d}{\sqrt{S(d_t^2)}} \right) + \frac{u_t}{\sqrt{S(d_t^2)}} \left(\frac{R_d}{\sqrt{S(d_t^2)}} - r_{ad} \frac{R_a}{\sqrt{S(a_t^2)}} \right) \right\}}{\frac{R_b^2}{S(b_t^2)} + \frac{R_c^2}{S(c_t^2)} + \frac{1}{1 - r_{ad}^2} \left(\frac{R_a^2}{S(a_t^2)} - 2r_{ad} \frac{R_a R_d}{\sqrt{S(a_t^2)} \sqrt{S(d_t^2)}} + \frac{R_d^2}{S(d_t^2)} \right)}.$$

This formula for finding the i 's was used, the values of the R 's being those given on p. 145, and the values of the $S(a_i^2)$, etc., those on p. 146 derived from the computed a 's, etc.

From the i 's thus calculated we get the a 's, the b 's, etc., and have from the latter, $S(a_i^2) = 30.5$, $S(b_i^2) = 81.5$, $S(c_i^2) = 27.2$, $S(d_i^2) = 6.3$.

These compare with the values given on p. 146, 31.35, 80.05, 19.92, 8.11. The correlation between a and d is -0.93 . The other correlations are not sensible.

In view of these results it seemed necessary to go back to the original data and recalculate the R 's, using now only five equations, $R_a R_b = 198.83$, $R_a R_c = 230.63$, $R_b R_c = 240.28$, $R_b R_d = 278.61$, $R_c R_d = 360.19$, thus leaving out $R_a R_d$, which is not now assumed to be approximately equal to 244.76. (These figures are given on p. 145, *loc. cit.*)

From these we get $R_a = 13.71$, $R_b = 13.87$, $R_c = 17.34$, $R_d = 20.49$. The products of the R 's in pairs give

$$R_a R_b = 190.12, R_a R_c = 237.73, R_b R_c = 240.59, R_b R_d = 284.20, \\ R_c R_d = 355.38.$$

These may be compared with the values of $S(x_i y_i)$, etc., given above.

In view of the high correlation which appears to exist between the a 's and the d 's, we proceeded to assume that there was an exact relationship between them, *i.e.* we assumed that $d_i = k a_i$, where k is a constant. On this assumption, we shall have approximately the following relations :

$$R_a^2 + S(a_i^2) = S(x_i^2) = 200.05, \\ R_d^2 + k^2 S(a_i^2) = S(u_i^2) = 409.43, \\ R_a R_d + k S(a_i^2) = S(x_i u_i) = 244.76.$$

Substituting in these equations the values of the R 's just found, we get equations which will lead to k and $S(a_i^2)$. They are

$$S(a_i^2) = 12.20, k^2 S(a_i^2) = -10.37, k S(a_i^2) = -36.06.$$

These give $k = -0.638$, $S(a_i^2) = 19.70$.

We are now assuming that

$$x_i = r_a i_t + a_i, \text{ and } u_i = r_d i_t + k a_i.$$

Therefore $-k x_i - u_i = (-k r_a + r_d) i_t$.

Or we may write this as

$$\frac{i_t}{\sqrt{S(i_i^2)}} = \frac{0.638 x_i + u_i}{0.638 R_a - R_d},$$

from which we may proceed to get the individual $r_a i$'s, the $r_b i$'s, the $r_c i$'s, and the $r_d i$'s. from which again we get the a 's, the b 's, the c 's,

the d 's, by subtraction from the x 's, the y 's, the z 's, the u 's, in the same manner as described previously (p. 145, *loc. cit.*).

When this is done we get the following values for the sums of the squares :

$$S(a_i^2) = 25.29, S(b_i^2) = 79.89, S(c_i^2) = 34.40, S(d_i^2) = 10.23.$$

The standard errors of measurement obtained from these are

$$s_a = 0.73, s_b = 1.29, s_c = 0.85, s_d = 0.46.$$

These may be compared with the corresponding values obtained previously (p. 146, *loc. cit.*), 0.81, 1.29, 0.64, 0.41.

The general conclusions are the same as before, viz. that the degree of precision in these indices is indicated by a standard error of about 0.5 or 1.

The correlations between the various elements are given below :

$$\begin{aligned} r_{ia} &= -0.00, r_{ib} = -0.11, r_{ic} = -0.18, r_{id} = -0.09, \\ r_{ab} &= +0.18, r_{ac} = -0.15, r_{ad} = -0.99, r_{bc} = -0.27, \\ r_{bd} &= -0.19, r_{cd} = +0.13. \end{aligned}$$

All these correlations, with the exception of that between a and d , are of insignificant amounts. Thus, the results obtained fit in with the assumptions on which this new analysis is based.

A POSSIBLE EXTENSION OF STATISTICAL METHOD.

By TERENCE WHITE, F.Ph.S.(Eng.).

It would seem that an ultimate end of all statistical and mathematical sciences, as well as of quasi-mathematical sciences such as the analysis of musical interpretation, could well be the establishment of a *Science of Order Itself*. In this science there would have to be included, not only measurement of physical units as we know it, but also measurements of what are at the moment called mental, psychological, and spiritual units. Towards the achievement of this end statistical methods, as at present constituted and understood, can open great avenues.

Now, statistics, as statisticians must too well realize, is at best a science of approximation: it is but rarely that complete and comprehensive accuracy is obtained.

How is this element of approximation in statistics related to human psychology? In three chief ways. In every statistical investigation enter the psychology of the statistician, and also that of the human relations of the subject studied. And both of these may cause a deviation from complete accuracy in the results.

The third connection with psychology is, by a paradox, formed by a somewhat opposite cause to the first two: in fact, just the absence of adequate statistical treatment of, and data with regard to, those psychological facts and units which are at work in almost every subject of statistical study.

For the number of different things in the world, and their classification, are conditioned not alone by forces which are obviously countable; and the recognition of psychological factors, as causes, consequences, and parallelisms, and their utilization as contributors in the creation of fresh units as well as in the classification of recognized ones:—this, far from leading exact science into a *cul de sac*, constitutes actually a road to a greater clarity in the organized perception of fact.

Further, the difference between the physical and the mental or affective can often be expressed by a break or an inaccuracy in what would have been the complete tabulation of the physical: just as sensitive artistic rhythm consists in a subtle ordering of these—at times microscopic, at times enormous—inaccuracies.

And if it be asked, "Can the science of statistics deal with the spiritual?" it may be answered that the spiritual often shows itself, in the physical world, by intruding on the physical and material in their own province. Thus statistics can begin to catch

the spiritual with the tools it uses for catching the material sides of life.

Here, then, is one opening in the important matter of Method. Further such openings are, however, possible: mainly in the following directions. First, through the extension of (methodological) units which are already in use in statistics: these units may be divided into two classes, those whose present use is factually based on psychological distinctions, and those that give promise of being capable of extension into such use. To the first class belongs, for instance, the distinction between Biased and Unbiased Errors. To the second class, methods such as Interpolation; the distinction between Average and Mode; Skewness; the whole science of Correlation; the concepts of Index-numbers and of Weights.

Again, many devices for the measuring and tabulating of mental and non-material phenomena may be found by using the methods of physical statistics, combined with the realization that a Mean in statistics may be found identical with a particular End in "spiritual" statistics; and that within an evolution a change in quality tends to be preceded by a succession of relevant changes in quantity.

ESTIMATE OF THE JEWISH POPULATION OF LONDON IN 1929-1933.

By MIRON KANTOROWITSCH, Ph.D. (Berlin).

An Abstract of a Report prepared for the Statistical Committee
of the Jewish Health Organization of Great Britain.

Introduction.

FOLLOWING the method employed by Mr. H. L. Trachtenberg for 1929, burial returns have been used to estimate the population in the later years.* A slight alteration has been made in his figures for the year 1929 to give effect to revisions in the returns of some Burial Societies.

As the figures for the general population of Greater London are not available earlier than for the year 1931, the statistics have been arranged so as to show the estimate of the Jewish population in the Administrative County of London, in the area covered by the *New Survey of London Life and Labour* for the years 1929-33 and in Greater London for the years 1931-33.

I.

Mr. H. L. Trachtenberg, criticizing an earlier estimate, pointed out that the use of death-rates *at ages* in order to estimate a total Jewish population was advantageous

“in that there is a fair possibility that errors in some age-groups due to the assumption of the London proportions may have opposite directions in other groups and thus tend to cancel one another in the total.” †

The following consideration illustrates this point.

Expressing the number of deaths of the female age-group 5-14 years among the general population, and also among the Jewish population of the Administrative County of London, as percentages of the corresponding numbers in 1929, we arrive at the following figures :

* “Estimate of the Jewish Population of London in 1929.” By H. L. Trachtenberg, B.A., *Statistical Journal*. Vol. XCVI, Part 1, 1933, p. 87. The method has been described on p. 93.

† H. L. Trachtenberg, *loc. cit.*, p. 91.

Year	General Population.		Jewish Population.	
	Number of Deaths.	Per cent of 1929.	Number of Deaths.	Per cent of 1929.
1929	629	100	32	100
1930	547	87	10	31
1931	528	84	25	78
1932	509	81	23	72
1933	576	92	16	50

There seems to be something wrong with this age-group among the Jewish female population of London, but a scrutiny of the burial returns failed to reveal any errors considerable enough to explain this discrepancy. As we have to reckon with this fact, we cannot consider each age-group separately, but must use only the total results of our estimate.

The figures obtained for the female age-group 5-14 years of the Jewish population of the Administrative County of London for the years 1929 and 1930 respectively are as follows, the figures in brackets being the standard errors: 1929—17,683 ($\pm 3,138$), and 1930—6,175 ($\pm 1,965$).

Our estimate of the Jewish population of the Administrative County of London for the years 1929 and 1930 respectively (all age-groups together) is:

Year.	Males	Females.	Both Sexes
1929	82,007 ($\pm 4,320$)	95,739 ($\pm 5,134$)	117,746 ($\pm 6,710$)
1930	97,313 ($\pm 5,036$)	89,485 ($\pm 4,797$)	186,798 ($\pm 6,955$)

The difference of the estimates of the female populations in the age-group 5-14 years for the two years 1929-30 is 11,498, or 4.6 times the probable error 2,497, and is therefore significant, but the difference between the two estimates of total female population is 6,254, or only 1.3 times the probable error 4,739 of the difference. Similarly the difference between the two estimates of total population of both sexes 9,052 is only 1.4 times the probable error 6,518. We thus see that although the estimates for age-groups are not reliable, a good deal of confidence may be attached to the estimates of total population of each sex and for the two sexes together.

There is another reason why the results obtained for the estimate of the Jewish population for the year 1930 ought to be excluded from our consideration: our estimate shows 97,313 male population against 89,485 female population. Thus the number of Jewish males in the year 1930 seems to be greater than the number of Jewish females. Neither the estimates made by our predecessors nor our

own estimates for the rest of the quinquennium 1929-33 show any preponderance of males. It therefore seems doubtful whether the figures obtained for the estimate of the Jewish population for the year 1930 are a good approximation to the real number of the Jewish population during this year. In fact, the observed difference 15,306 between our estimates of Jewish male population for the years 1929 and 1930 is 3·4 times as great as the value 4,475 of the probable error of this difference, and may therefore be significant.

The following table also shows some abnormality. Expressing the number of deaths both of the general population and of the Jewish population in the Administrative County of London as percentages of the corresponding numbers in the year 1929, we get :

General Population.				Jewish Population.			
Number of Deaths.				Per cent. of 1929.			
				Number of Deaths.			
				Per cent. of 1929.			
1929	...	...	62,889	100	2,043	100	
1930	...	...	50,992	81	1,953	95·5	
1931	...	...	55,234	88	2,009	98	
1932	...	...	53,611	85	2,035	99·6	
1933	...	...	53,536	85	2,086	102	

The Jewish population shows an increase in the number of deaths in the years 1932 and 1933. Checking the burial returns, no mistakes were found—the total reported by the burial societies corresponded to that in their books, and in the books each entry has its own number. The total in the books must equal the number of certificates issued by coroners. The Burial Societies are not allowed to inter the body until they have received such a certificate. The increase in the number of deaths among the Jews would therefore seem to be a fact. Of course, our material does not make it possible to explain this satisfactorily. It may be hazarded that the high Jewish mortality in 1932 and 1933 is associated with the abnormal age-composition of the Jewish population.

Though we based our estimate of the Jewish population on the death returns, and have assumed that the mortality among the general population and among the Jews was the same, we must bear in mind that the age-composition of Jews may differ from that of the general population. Indeed, it is very likely that the Jewish population has a relatively higher percentage of the old people than the general population.*

The following considerations may confirm this. Professor A. L.

* It is immaterial that the Jews are included in the general population as well for the percentage of the Jewish population is very small, as we shall see below.

Bowley says in his contribution to the *New Survey of London Life and Labour*,

"The percentage born abroad rose from 2.7 in 1881 to 3.2 in 1891, 4.3 in 1901 and 4.7 in 1911, after which it declined slightly to 4.3 in 1921.

It will be seen that the last-named element (*i.e.* born abroad) has throughout the period been a small proportion of the whole. *Its increase between 1881 and 1911 is mainly due to the influx of Jews from Eastern Europe into East London,** while the check to the increase between 1911 and 1921 was undoubtedly connected with the war." †

Hence it follows that (1) the number of immigrants did not appreciably affect the general population of London, but (2), on the other hand, the immigrants could represent a considerable part of the Jewish population.

Dr. A. E. C. Hare and Mr. M. I. Michaels are of opinion that

"Jews form by far the largest part of the foreign-born working-class population of London, particularly in the area under examination" (*i.e.* the area covered by the *New Survey of London Life and Labour*)—and further :

"The age distribution of the Jews indicates an old population, which of course mainly reflects the post-war restrictions on foreign immigration. Two-thirds of the foreign-born adult males, compared with under half the Londoners, were over 45 years of age." ‡

The results of censuses of England and Wales of the years 1901, 1911, 1921 and 1931 supply the following data, which may give further confirmation of our assumption.

In the years 1901 33.4 per cent., 1911 33.5 per cent. and 1921 37 per cent. of the total foreigners were Russians or Poles.§ The Census for the year 1931 shows that out of 58,667 foreign-born persons of alien and unstated nationality who had their birth-places in Poland, Rumania and Russia, 34,274 (58.42 per cent.) belonged to the age-groups 45 and upwards and 19,172 persons (32.68 per cent.) to the age-groups 55 and upwards.||

* The italics are ours (M. K.).

† Professor A. L. Bowley, "Area and Population," *The New Survey of London Life and Labour*, Vol. I, p. 68. London, 1930.

‡ Dr. A. E. C. Hare and Mr. M. I. Michaels, "Migration and Population," *The New Survey of London Life and Labour*, Vol. VI, p. 240. London, 1934.

§ See Census of England and Wales, 1921, General Report, Table LXIV, p. 154.

|| We assume that nearly all immigrants from Russia, Poland and Rumania are Jews. Of course among foreigners from Russia there are some Gentiles who are refugees and who are included in the censuses of 1921, and especially

It is further well to remember that the Census of England and Wales for the year 1931 shows that out of 84,655 persons born in Poland, Rumania and Russia, 63,085 (74.52 per cent.) lived in London and the five surrounding counties; 61,869 persons (73.08 per cent.) in Greater London and 53,061 persons (62.68 per cent.) in the Administrative County of London.*

As we know that the year 1914 saw the practical cessation of immigration from East Europe to this country, all these figures may perhaps contribute to explain why the number of Jewish deaths in London since 1932 was relatively higher than that of the general population.

II.

Returning to our estimate, it may be considered that it is of little use to give the results of the Jewish population by age-groups, for the reason referred to above. We prefer, therefore, to give only the total results of our estimate for separate years, and only include separate figures for sex and age-groups in the averages of our estimates for the years 1931-33.

The following table shows the estimate of the Jewish population in the area covered by the *New Survey of London Life and Labour* in the years 1929 and 1930 †† (the figures in brackets being standard errors) :

Years.	Males.	Females.	Both Sexes.
1929	91,220 ($\pm 4,573$)	103,499 ($\pm 5,405$)	194,719 ($\pm 7,080$)
1930	102,771 ($\pm 5,038$)	95,745 ($\pm 4,990$)	198,516 ($\pm 7,091$)

The figures of our estimate of the Jewish population for the year 1929 show only a slight difference compared with those arrived at by Mr. H. L. Trachtenberg, and they do not show any difference in the trend.

As we have pointed out above, the figures shown in our estimate of the Jewish population for the year 1930 look a little strange because of the rather abnormal high number of males shown for this year.

of 1931, but we do not believe that the number of such persons is very large. On the other hand, there are possibly some Jews born in Galicia who have perhaps given their birthplace as Austria instead of Poland. Besides, there are some Jews among the immigrants whose birthplaces are Germany, Lithuania, Latvia, etc., and who have not been included in our statistics of Jewish immigrants concerning the data of the Census of 1931.

* See Census of England and Wales, 1931, General Tables, Table XXXIII, p. 235, and Table XXX, p. 179, respectively.

† For the figures for the Administrative County of London, see p. 377.

† See H. L. Trachtenberg, *loc. cit.*, pp. 97 *seq.*

Our estimate of the Jewish population for the rest of the quinquennium 1929-33 is as follows :

Year.	Males.		Females		Both sexes.	
	Population	Standard Errors.	Population.	Standard Errors.	Population.	Standard Errors.
Greater London.						
1931	105,286	($\pm 5,300$)	126,793	($\pm 6,231$)	232,081	($\pm 8,180$)
1932	104,420	($\pm 5,082$)	136,578	($\pm 6,568$)	240,998	($\pm 8,305$)
1933	113,417	($\pm 5,204$)	117,844	($\pm 5,903$)	231,261	($\pm 7,870$)
Administrative County of London.						
1931	79,946	($\pm 4,555$)	102,182	($\pm 5,487$)	182,128	($\pm 7,068$)
1932	82,167	($\pm 4,412$)	107,211	($\pm 5,693$)	189,378	($\pm 7,202$)
1933	83,311	($\pm 4,270$)	97,381	($\pm 5,012$)	180,692	($\pm 6,587$)
New London Survey Area.						
1931	89,200	($\pm 4,700$)	111,866	($\pm 5,725$)	201,066	($\pm 7,407$)
1932	89,995	($\pm 4,590$)	121,628	($\pm 6,047$)	211,623	($\pm 7,593$)
1933	93,442	($\pm 5,548$)	110,791	($\pm 5,270$)	204,233	($\pm 6,961$)

Considering our statistics for each separate year, we have come to the conclusion that it is not advisable to compare one year with another in order to get any idea of the movement of the Jewish population, and that it is better to consider the statistics not of each separate year, but of an average of several years. If particular years show irregularities—and that seems to be the case in our estimates—the average would tend to smooth them out.

In order to smooth these irregularities, we decided to calculate the average of our estimates for the years 1931-33 only, and to omit the year 1930 for the reason mentioned in connection with the estimate for the year 1930.

Average Jewish Population in Greater London, 1931-33.

Age-Group.	Males.		Females.	
	Population.	Standard Errors.	Population.	Standard Errors.
0-	5,887	(± 326)	5,248	(± 367)
5-	16,271	($\pm 1,789$)	16,324	($\pm 1,872$)
15-	16,834	($\pm 1,460$)	24,511	($\pm 1,908$)
25-	14,789	($\pm 1,353$)	25,564	($\pm 1,791$)
35-	15,793	($\pm 1,023$)	17,654	($\pm 1,210$)
45-	16,910	(± 699)	18,284	(± 893)
55-	11,635	(± 398)	13,335	(± 537)
65-	4,995	(± 170)	7,029	(± 227)
75 and over ...	1,172	(± 51)	1,756	(± 68)
Total	104,286	($\pm 2,999$)	129,705	($\pm 3,618$)
Grand Total : 233,991 ($\pm 4,699$).				

*Average Jewish Population in the Administrative County of London,
1931-33.*

Age-Group.	Males.		Females.	
	Population.	Standard Errors.	Population.	Standard Errors.
0-	4,164	(\pm 237)	3,610	(\pm 267)
5-	12,196	(\pm 1,405)	12,774	(\pm 1,614)
15-	13,915	(\pm 1,312)	20,254	(\pm 1,689)
25-	13,770	(\pm 1,138)	20,016	(\pm 1,526)
35-	11,238	(\pm 793)	13,552	(\pm 1,015)
45-	12,701	(\pm 558)	14,002	(\pm 761)
55-	8,930	(\pm 329)	10,961	(\pm 464)
65-	4,001	(\pm 147)	5,641	(\pm 208)
75 and over ...	893	(\pm 42)	1,445	(\pm 60)
Total	81,808	(\pm 2,528)	102,255	(\pm 3,119)
Grand Total: 184,063 (\pm 4,015).				

Average Jewish Population in the New London Survey Area, 1931-33.

Age-Group.	Males.		Females.	
	Population.	Standard Errors.	Population.	Standard Errors.
0-	4,689	(\pm 272)	3,915	(\pm 281)
5-	13,501	(\pm 1,572)	14,320	(\pm 1,685)
15-	15,190	(\pm 1,367)	21,882	(\pm 1,736)
25-	15,642	(\pm 1,222)	23,276	(\pm 1,631)
35-	12,335	(\pm 831)	15,340	(\pm 1,092)
45-	13,915	(\pm 591)	15,955	(\pm 803)
55-	9,869	(\pm 346)	12,221	(\pm 489)
65-	4,408	(\pm 154)	6,266	(\pm 219)
75 and over ...	993	(\pm 45)	1,587	(\pm 63)
Total	90,542	(\pm 2,663)	114,762	(\pm 3,274)
Grand Total: 205,304 (\pm 4,220).				

Considering these tables, we believe we can accept the fact that the Jewish population in Greater London is about 234,000, that the number of Jewish persons within the borders of the Administrative County of London is about 184,000 and the Jewish population within the area covered by the *New Survey of London Life and Labour* is about 205,000.

Hence it follows that it is probable that some 79 per cent. of the Jewish population of Greater London live in the Administrative County of London, and some 88 per cent. of "London" Jews live in the New London Survey area.

It follows further that the proportion of the sexes in the Jewish population are : .

				Greater London. Per cent.	Administrative County of London. Per cent.	New London Survey Area. Per cent.
Males...	...	...	...	44.57	44.45	44.10
Females	...	...	...	55.43	55.55	55.90

Finally, we can conclude from our statistics that the Jewish population forms 2.82 per cent. of the general population in Greater London and 4.24 per cent. in the Administrative County of London.

III.

The statistics we have arrived at show only the state of the Jewish population of London, but not its movement. In order to arrive at the latter, it is important that the statistics of Jewish births should be available. It may be possible to approximate to the figure of births by collecting data with regard to the number of Jewish circumcisions and treating the ratio of male to female births as constant.

It should be borne in mind that where there is a Jewish population, all available statistics show everywhere, and especially in Central and Western Europe, that the birth-rate of the Jewish population is lower than that of the general population. Does the Jewish population of this country, and especially of London, show the same tendency? This important question cannot be answered until statistics such as those of circumcisions, from which birth-rates may be estimated, are available.

I am under a deep obligation to the members of the Statistical Committee and its Investigation Committee for their advice and criticism during the progress of this piece of research work. My thanks are due also to the officials of Jewish Burial Societies and to the Secretary and Officials of the Jewish Health Organization for their invaluable help. Finally, I would like to thank the Professional Committee and the Central British Fund for German Jewry, who have enabled me to carry out this work.

REVIEWS OF STATISTICAL AND ECONOMIC BOOKS.

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1.—*International Institute Examinations Enquiry: An Examination of Examinations.* By Sir Philip Hartog, K.B.E., C.I.E., and E. C. Rhodes, D.Sc. London: Macmillan, 1935. 9" x 6". 81 pp. 1s.

An examination is, in pedagogy, the testing of an individual, or something of his creation, by a tester investigating certain properties of the individual. Although there are various theories relative to the appropriate allocation to the examinee of a symbol, yet it seems that ultimately the question is analogous to that of any other measurement, *i.e.*, we use a number. Actually some examiners work by impression and some by detailed analysis: some assign literal marks and some numerical symbols. But whichever method is adopted the effect is that the various candidates, or their performances, are marked along a scale, one extreme exhibiting the greatest measure of the qualities assessed and the other extreme the least measure. And if an examiner has a number of candidates to rank, he usually proceeds by "finding his standard" either by a preliminary scanning of the scripts or by drawing on his previous experience to use his range of available marks as usefully as possible, so that the worst candidate gets nearly or actually the minimum, the best candidate nearly or actually the maximum, and the average candidate some middle mark. This will apply whether the tester is assigning points to a written script, to impressions given in a personality interview, to a pianoforte performance, to ice-skating figure-work or what not. In this Journal (Vol. LI, 1888, pp. 599-635; LIII, 1890, pp. 460-475; LXXXVI, 1923, pp. 59-60) Prof. F. Y. Edgeworth pointed out some of the errors that arise in marking Examination papers. These are summarised in the *Forum of*

Education, Vol. IV, Part 3, Nov. 1926, p. 233, where the present reviewer called attention to this work. It seems remarkable, however, that such an important problem of mass measurement as that involved in the marking of examinations should have received so little attention from theoretical statisticians, particularly in view of the fact that so many of them must in the course of their academic work be brought up against the problem. Of competent statisticians practically the only one since Edgeworth who has dealt with any of the problems suitable for treatment by the statistical calculus has been Caradog Jones (see, *e.g.*, *Secondary School Examinations Statistics*, by Crofts and Jones, 1928, and to a smaller extent Godfrey Thomson. Many writers, devoid of statistical training, have dealt inadequately with the problem, however, so it was with considerable satisfaction that statisticians interested in the problem learned that, as a result of an International Conference on Examinations held in 1931, an English Committee of the International Institute Examinations Enquiry had been set up, and was being assisted in its investigations by Dr. Rhodes, Reader in Statistics of the University of London. The Committee has conducted work on various lines, it has published a bibliography and is preparing a conspectus of the various examinations conducted in England. The present work is chiefly a comparison of marks allocated to actual examination scripts by independent and experienced examiners.

In valuing any script there are three main elements to be considered :

(a) What is an average performance in the examination and what mark should be assigned here? Differences between various examiners in their estimate of this will here affect the average mark and in the mass can be discovered when the work is repeated by comparing the average marks of the examiners concerned.

(b) What is the range in the examination and how should fluctuations on either side be valued? Differences here affect the scatter of the marks, and two examiners can be compared in their work by any measure (*e.g.*, standard deviation, quartile difference, etc.) of the scatter.

(c) What is the random variation of the examiner about the mark that he would assign if his standard and scale were quite definite but his measure evaluations, like any measurement, fluctuate about this "true" or "ideal" mark?

Examining bodies have long been aware of these three features. The first two are corrected as a matter of routine in any big examination by "standardization" (vide *Report of the School Certificate Examination*, H.M.S.O., 1932, pp. 36, 37), by which any particular examiner's marks are scaled up or down according apparently to a linear law. But the last has eluded mathematical correction and attempts have alternatively been made by use of school records, appropriate instructions, meetings of examiners, and so forth to ensure that the examiners' random variations are kept to a minimum. This random variation is what the reviewer has recently (*British*

Journal of Educational Psychology, Vol. V, Part II, June 1935, pp. 183-186) called Fluctuation E, the Grading Fluctuation. From time to time we suspected all was not well. Stories of American experience, some of the allegations of supporters of "new-type" tests, small books by Boyd and Perrie Williams, the "Durham experiment," anecdotes and badly presented investigations were very unsettling. And our fears were not allayed by the preposterous claims made by certain examiners—*e.g.*, one well-known chief examiner claimed his marks were accurate to one point in 200. After all, Edgeworth's suggestion of errors of 2, 3 or 5 per cent. seemed, if anything, too low. Taking the *s.d.* of the ordinary examination (max. 100) as, say, 15 marks (*vide* graphs at end of Caradog Jones) and the fact that the correlation of teachers' estimates with ultimate success is for subject by subject of the order of 0.65 (Caradog Jones, p. 47), we have the *s.d.* of the candidate's mark about his true mark is $15\sqrt{1-0.65^2} = 11$, a figure much greater than Edgeworth's estimate. This value covers not merely the Grading Fluctuation, but also some of the others (Fluctuations A, B, C and D) covering the cases, *e.g.*, of the questions not suiting the candidates, the candidates being off colour, etc. The figure obtained by Dr. Rhodes is of the order 8 to 12 per cent. per question and 3 to 6 per cent. per paper—that is to say, an examiner may, taking the figure as 5 per cent. per paper, fluctuate, exceptionally by 15 per cent. more or less than the true mark that he would usually give to any particular script. Some examiners are more variable than others.

The investigation covered all types of work—that of children of 11+, of 16+, of 18+ and of degree candidates, work in Arithmetic, English, including Essay, History, French, Latin and Chemistry, work marked by independent examiners and work marked by boards of examiners, written scripts and *viva voce* examinations, work marked by letters and work marked by numbers, work marked by impression and work marked in detail, work marked by the same examiners at two different epochs (not less than 12 nor more than 19 months apart), work all originally assigned the same middling mark and work chosen to range from the worst to the best through a normal frequency distribution. In all cases there was an unsteadiness of the marks, in some cases very considerable. Sir Philip Hartog and Dr. Rhodes have been as a result subjected to a large amount of criticism that has by those ignorant of statistics been extended to all examinations. But even the considered reply of the best of the examination bodies to take the public into its confidence merely concludes by giving a table, for the school certificate examination as a whole, that leads by tetrachorics to a value of *r* of the order of 0.95 and thus an *s.d.* for the examination of $15\sqrt{1-0.95^2} = 5$, still greater than Edgeworth's figure, although the school certificate examination is probably based on some ten different papers. This fluctuation of *s.d.* 15 (say) per paper covers all the types of fluctuations above and is not inconsistent with Rhodes' value for the grading fluctuation alone, and thus the criticism that has been made that the Institute's method of standardization was obsolete and inefficient seems of little value. The

sooner it is realized that a correlation of 0.95 is of the same order as that between the right and left long bones of any individual or between physical measurements of identical twins, the sooner will the statisticians be able to satisfy the ordinary person that examinations do really, when well conducted, provide quite a good measuring rod, but one that occasionally makes a big mistake and often makes small ones, and needs a competent statistician to watch its use and see it is not abused. And to this end the work of Sir Philip Hartog and Dr. Rhodes can help very considerably to point the way.

We note that p. 31 appears to contain several omissions. Asterisks should be attached to candidates Nos. 13, 17, 21, 40, 41, 44 and 45. We should like to have seen the references to the examiner's random variations made in several cases more definite by indicating each time whether they were per question or per script, and the maximum marks in each case.

F. S.

2.—*The General Theory of Employment, Interest and Money.* By John Maynard Keynes. London: Macmillan, 1936. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. xii + 403 pp. 5s. net.

This new statement of his economic belief and outlook is chiefly addressed, Mr. Keynes says in his preface, to his fellow-economists. He claims that it is they, and not the general public, who must first be convinced by his arguments, and, until a decision is reached on the grave points at issue, the general public must be content to be onlookers. The Royal Statistical Society includes among its Fellows a large number of economists, and the Society has given considerable attention in recent years to the statistical measurement of income and savings, concepts which are fundamental in the economic framework proper to Mr. Keynes' new views. The point of departure from which those views are developed, and their general character, may thus find among our Fellows a particular degree of sympathy.

The author describes his book as "primarily a study of the forces which determine changes in the scale of output and employment as a whole." This study leads "to a more general theory, which includes the classical theory with which we are familiar, as a special case." As such, economists will find that they are called upon to consider familiar doctrines in a new setting, and, in so doing, they should find their efforts rewarded by a better understanding of many difficult points of theory. This gain may be expected whether they find themselves in general agreement with Mr. Keynes, or, like the present reviewer, unable to reconcile the statement just quoted from the preface with the statement on the dust-cover of the book, that it "constitutes a general assault on the adequacy of the existing orthodox economic theory" for certain purposes named, a description which is, indeed, an understatement of the vigour and generality of the challenge to that theory that is repeated and developed in a degree that obstructs, rather than assists, the presentation of the very real and important contributions to economic understanding which, and not the discrediting of the classical teaching, must be the real purpose of the book.

As a study of changes, including the conditions which make change desirable, the book naturally presents a view of the economic world from a standpoint different from that of most of the writers of a generation ago, who were concerned, in the main, with the conditions of economic equilibrium. The problems of equilibrium may be solved, if our data and logical apparatus are adequate, as special cases of a more general analysis. As an alternative, if the more general analysis presents difficulties that cannot be attacked directly, an insight into the general character of the universe we are studying may be obtained by a preliminary examination of a simplified hypothesis of forces so balanced as to give no stimulus to immediate change, reserving problems of change for later handling, when familiarity is established with the relations of a world from which change has been provisionally excluded. Differences of emphasis, of outlook and of presentation naturally result from these two modes of approaching the complex realities of life.

Within the necessarily narrow limits of a review, but an inadequate sketch is possible of the manner in which the main problems are approached. It may be best to begin by saying that the inhabitants of Mr. Keynes' economic world are, so far as the book shows, made up of entrepreneurs, rentiers and wage-earners. All varieties of labour, unskilled or skilled, manual or intellectual, are included in the third group, and it is even not quite clear whether entrepreneurs are not thought of as both employers and employed, combining the two functions in one person. Rentiers are not often mentioned: when not specifically named, it is possible that, as controllers of a special class of services, they may be included in the third group. The labour unit is an hour's employment of ordinary labour, special labour being weighted in proportion to its remuneration. The money-wage of a labour-unit is the wage-unit, and in this unit, for many purposes of the book, values are measured. Proceeds in wage-units are compared with expenditure of effort in labour-units.

The income of the present results from decisions taken, at various periods of the past, to employ labour and to use equipment, previously owned or specially acquired, in the expectation that the employment will yield products from whose sale the outlay incurred may be recouped. Thus the payments of the present, made to various factors of production for current services, and the profits of the entrepreneurs, realized from the disposal of such of their output as becomes currently ripe for disposal, provide at once the current income and the means both of replacing materials used up and of maintaining equipment that would otherwise depreciate from wear and tear and obsolescence. This abbreviated statement ignores inconvenient fluctuations in the rate at which products become ripe for disposal.

In taking as given the existing technique, social structure and available equipment and labour supply, we are, in fact, assuming that a bewildering variety of changes are capable of being ignored without invalidating the conclusions reached. The present flow of income bears the stamp, not of the technical possibilities of the present, but of those of many different past periods, in which those decisions were taken from which the character and volume of present output and

present employment have mainly resulted. These observations are, it might seem, superfluous, were it not that present income appears to invite consideration as the result of current technical conditions of production. Present technical possibilities may differ from present technical conditions, and the latter may be liable to quicker changes than the former. Some approximation to an assumption resembling that of equilibrium seems inevitable if we are to have definiteness in the problems examined, and concentration on the features which condition the kind and extent of change in the immediate future may result in conceptions having no stronger claim to be judged "realistic" than those resulting from concentration on problems of equilibrium. If these things be not forgotten—and it is by no means suggested that any of them were forgotten by Mr. Keynes—his presentation of the relations between employment, income and investment should add considerably to the just appreciation of the working of the economic machine. It may be noted that, since the publication of his treatise on "Money," he has extended the connotation of the word "income" so as to correspond more closely with what has been generally accepted. The result is that the elaborate structure of doctrine, erected on the foundation of a varying gap between savings and investment, must be abandoned, since net savings are, according to the new view, co-extensive with net investment. Before passing to a different topic, it may also be noted that, the expectation of income being given a leading place in the determination of the amount of employment, the divergencies between expectation and realization that occur in actual life may account for the primary importance attached to change, as against balance, and, by their influence on current expectations, may furnish the main stimulus to change.

In discussing "the propensity to consume" and "the inducement to invest," two views of the outlook find expression. On the one hand, "Each time we secure to-day's equilibrium by increased investment we are aggravating the difficulty of securing equilibrium to-morrow" (p. 105). On the other hand, "we might aim in practice (there being nothing in this which is unattainable) at an increase in the volume of capital until it ceases to be scarce" (p. 376). As capital "is kept scarce because of the competition of the rate of interest on money" (p. 213), "only experience can show . . . how far it is safe to stimulate the average propensity to consume without forgoing our aim of depriving capital of its scarcity-value within one or two generations" (p. 377). The pessimism of the first of these views of the future has been dispersed under the influence of the conviction that the rate of interest is subject to control by authority, through the regulation of the quantity of money. If the powers of the State are used to ensure that certain conditions of the existing régime are removed—among them the scarcity of capital—Mr. Keynes believes that an adequate measure of freedom of enterprise and of individual initiative may be retained. Apart from the redistribution of wealth-ownership that may be effected through taxation, the leading feature of the desired system appears to be the control of the monetary circulation. It need hardly be said that

international agreement in the convertibility of paper currency in terms of a selected metal or other commodity is not recommended. The argument clearly indicates that, for international use, commodity money is eminently unsuited. It is strikingly expressed in the phrase (p. 235): "Unemployment develops . . . because people want the moon. . . . There is no remedy but to persuade the public that green cheese is practically the same thing and to have a green-cheese factory (*i.e.* a central bank) under public control."

"Money . . . is . . . a subtle device for linking the present to the future" (p. 294), but, "So long as there exists any durable asset, it is capable of possessing monetary attributes and, therefore, of giving rise to the characteristic problems of a monetary economy" (p. 294). How far this principle may modify the subsequent discussion of the effects of changes in the quantity of money is a problem that might be worth following up, did space permit. Perhaps it is included in the comforting assurance (p. 299) that "if we have all the facts before us, we shall have enough simultaneous equations to give us a determinate result." An act of faith is called for, and a like faith is required at other points where, as here, no attempt is made to demonstrate the correspondence between the number of equations and the number of variables to be determined by them. Of the more important considerations linking the volume of money to the rate of interest (a term which is defined to mean the complex of rates payable for the control of capital for different periods) one is the desire for liquidity on the part of the controllers of capital, and the extent to which interest must fall in order that the supply of money may be absorbed by those who, having the choice, prefer complete liquidity to the holding of capital in forms that may be exchangeable for liquid assets at a later date only with loss. A second is the degree in which opportunities for investment will be increased by the offer of capital at lower rates (p. 298).

We find ourselves involved in the mutual relations between, *inter alia*, the volume of capital, the rate of its accumulation, the extensibility of its uses, the rates of preference of present over future goods, the rate of interest, the balance of price movements and the quantity of money: some of the conceptions being more or less flexible, more or less precise, as used in one context or in another. To steer a course through this maze by tracing a series of links of causation, such as that variations in the rate of interest are controlled by variations in the volume of money, which thus determine the extent to which capital, in association with labour, is employed in productive enterprise, is to invite challenge at a multitude of cross-roads. To select particular illustrations as representative in character may so readily convey an erroneous impression that the reviewer is instinctively disposed to leave to those to whom the book is addressed the discovery of those points which, in each individual case, will appear to be of critical importance. In considering, for example, what is designated "the schedule of liquidity preference," a dominant place is necessarily assigned to the general state of confidence in the future, and the variations of that confidence. But such more prosaic influences as those dependent on the progress of invention and the

expansion of the material resources at the disposal of mankind must be given their due importance, and liquidity preference may dominate the situation in less degree than appears to be claimed.

"That the world, after several millennia of steady individual saving, is so poor as it is in accumulated capital-assets" (p. 242) does not seem to require, for its explanation, a reference to the essential properties of money. Much saving has been essentially short-period saving; depletion necessarily follows from the perishable character of a large part of the capital assets of most countries; and attention must also be given to the need for change in the character of capital assets to make them adapted to new developments in technical knowledge and to changes in individual desires as our physical environment is changed. The stress, in the passage cited above, is, perhaps, on the "individual" character of the saving. It should need no elaborate proof that, with the best intentions and most confident expectations, errors in regard to the kinds of capital assets created result in large and continuous dis-saving. The skill with which untrustworthy persons succeed in getting control of the accumulations of others, and dispersing them, is also too notorious to call for more than simple mention.

The complexity of some apparently simple factors in the argument may be illustrated by considering the measurement of the quantity of labour employed. The rate of remuneration of a particular kind of specially skilled, and thus specially scarce, labour is measured by the marginal productivity of that kind of labour in the existing organisation of industry. The degree of stability characterizing the relative magnitudes of the marginal contributions of different kinds of labour, as the organization changes with the passage of time, will have a large influence on the stability of the wage-unit, and the degree of validity of arguments that assume a fairly high degree of stability for the wage-unit may easily be over-estimated. To reach definite conclusions, the traditional, and reasonable, course of assuming a considerable degree of simplification of the problem is adopted. But it is necessary to watch with the extreme care the application of definite conclusions, so reached, as if they had something like universal validity, to cases in which it is by no means easy to clear up the point of the significance of the simplifying assumptions. This is elementary, but important. The new presentation of Mr Keynes' views will afford occasion for testing, in appropriate detail, the strength of the joints in his complex structure. But, in attempting the task, his fellow-economists will probably gain much that would not have been theirs if he had not invited them to submit their cherished beliefs to a new and severe examination. Some of them may find that fresh sign-posts have been provided along the road to which Pareto pointed forty years ago.

Mr. Keynes' distrust of sinking-funds may, perhaps, be as little warranted as the blind belief in sinking-funds of some early nineteenth-century politicians. His belief that abundance of capital is a threat to abundance of output, crystallized in the passage that seems to trace the wealth of ancient Egypt to the habit of building pyramids, may be found not to imply that extravagance is the high road to

prosperity for a poverty-stricken people. It may be found that special capital expenditure, initiated irrespective of its commercial profitability, will not necessarily draw in its train a proportion of employment in other industries such as would be associated with that amount of capital expenditure in a world the industrial shape of which was uniformly determined by considerations of commercial profit. There may be found some middle way between the euthanasia of the rentier and the dependence on Government bounty of the growing proportion of the population that is considered "too old to work," or, at least, to be paid for work they may do. The growth of direct new investment by entrepreneurs, stimulated to do their own saving by high rates for borrowing from others, combined with the effect of low rates in extending the use of annuities by the retired (a matter to which attention is drawn), may be deemed considerations that are not negligible in the reaction of saving to the interest rate.

The proposal that an offer of gilt-edged bonds of an adequate variety of maturities, on tap at stated prices, might provide a more effective means of monetary management than the single bank-rate for short-term bills, does not seem to be dependent on the acceptance of Mr. Keynes' general body of doctrine, or even of the special view that "Any level of interest which is accepted with sufficient conviction as 'likely' to be durable *will* be durable." A. W. F.

3.—*100 per cent. Money*. By Professor Irving Fisher. New York: Adelphi Company (London: Allen and Unwin), 1935. 8" x 5½". xx + 212 pp. \$2.50.

"The 100 per cent. money proposal," says Professor Fisher in his Preface, "—to raise reserve requirements against checking deposits from 10 per cent. or thereabouts to 100 per cent.—may at first seem startling. But it is an historical fact that in the earliest days of deposit banking, a 100 per cent. reserve was required."

Professor Fisher does not propose a 100 per cent. *metallic* reserve on the model of the seventeenth-century Bank of Amsterdam, but a 100 per cent. reserve of paper currency to be issued by a Government Currency Commission, which would hold credit assets (mainly if not entirely Government securities) against it. This reserve would be required against all demand or "checking" deposits, which would thus be in effect hardly distinguishable from obligations of the Currency Commission. The commercial banks could be allowed to retain their business in time deposits unaltered, and to carry on their usual business of discounts, loans, etc., within the limits of those deposits. But on the demand deposits they would make their profit either by a direct charge to the depositors, or by being allowed to receive the interest on the securities held by the Commission (p. 138). The system "would involve only a nationalization of the *monetary* function (now usurped by the banks)—not a general nationalization of *banking*. Money is properly a governmental function" (p. 183). Checking deposits would have "the legal status of trust funds" (p. 22). The primary purpose is to safeguard the depositors, and so to guard against panics. Professor Fisher supplies, as all who know his work will expect, an able and

lucid defence of his plan, carefully adapted to the mentality of the business man.

If *all* bank deposits were to be covered by 100 per cent. reserves, the banking system would be effectively nationalized. If the commercial banks survived, it would be to perform the purely mechanical process of clearing cheques and keeping books. Professor Fisher's plan is a compromise based on a division of function between the Government and private enterprise. The principal function of the latter would be to supply intermediaries between people who seek a temporary investment for surplus funds in the form of time deposits, and those who seek temporary advances.

Professor Fisher believes that the 100 per cent. system would facilitate monetary management with a view to stabilization of the price-level. "The present terrible evils could be largely corrected by money management alone, just as they could be largely corrected by the 100 per cent. system alone. . . . While either alone would work wonders, both would, in my opinion, be the ideal to be sought" (p. 92).

He is rather inclined to base his advocacy of the 100 per cent. system to some extent on the desirability of stabilization. There is, however, room for a good deal of doubt whether that system would facilitate monetary management. Professor Fisher would prefer the non-metallic backing of the paper currency issued by the proposed commission to consist exclusively of Government securities, and would only admit commercial rediscounts as a transitory arrangement at the outset (p. 20). But are not commercial rediscounts a more effective instrument for regulating economic activity than purchases and sales of Government securities in the market? No doubt, if the Currency Commission relied exclusively on an open-market policy, there would be an indirect effect on commercial bills and advances. The first impact of sales of Government securities would be felt in increased advances by the banks to the dealers in the stock market who bought them, and the banks, being unable to create demand deposits, would use the cash reserves held against time deposits to make these advances. In order to avoid depleting these reserves, the banks would take steps to reduce their other advances. That is not easily or quickly done. It is a common experience at a time of sudden credit stringency that traders cannot reduce indebtedness by selling off goods, and that at first aggregate advances are actually increased rather than diminished. In order that that may occur, the banks must have the power of creating deposits. If they have not, they will be compelled to refuse to grant advances, and the stock market will be disabled from buying securities with borrowed money. The Currency Commission's sales will be limited to such money as investors can be induced to lay out from balances by the offer of securities at low prices.

This loss of elasticity in the stock market (and indeed in all markets in which borrowed money is employed) would be one of the most important effects of the 100 per cent. reserve system, and Professor Fisher, though he devotes a chapter to the effect of the system on loans, never considers it. If commercial rediscounts

were admitted as a normal feature of the system, the requisite elasticity would be obtained. But if commercial rediscounts form part of the backing of the currency, they indirectly form part of the backing of the demand deposits, and the 100 per cent. becomes rather a fiction, except in the sense that the intervention of a public authority as an intermediary is equivalent to a 100 per cent. guarantee of deposits.

R. G. H.

4.—*The Fundamentals of Money.* By Henry Houston. London: P. S. King, 1935. 8½" × 5½"; ix + 221 pp. 10s.

One special reason, Mr. Houston frankly admits in his Preface, has prompted him to write another book about money: "I do not consider that any book recently published has dealt satisfactorily with the fundamental problems of the subject." There are important academic works on the one hand, and a number of elementary textbooks on the other, but the ground in between is relatively sparsely occupied. Hence this interesting attempt at synthesis and exposition.

The field covered must inevitably be a wide one, but Mr. Houston goes especially far. He begins with the origin of money, and devotes a considerable space to monetary history. Only towards the middle does he attack monetary theory proper: two chapters, one on the demand for money and the other on the supply, prepare the way for an exposition of central banking technique which leads, by way of a discussion of exchange rates and prices, to the trade cycle and the criteria of economic stability. The historical section is very readable, though perhaps not quite relevant from the point of view of the title of the book and its specific objective; there are dangers in lingering by the wayside at the beginning of what admittedly must be an arduous journey over difficult country. The chapter on the demand for money, on the other hand, does provide a real starting point. Mr. Houston firmly and effectively emphasizes the significance of money as a good in itself; it provides us with security against an unknown future. "It is frequently thought that money is only of value and only demanded for what it will buy. . . . If it were worth nothing except for the goods it buys it would be spent at once. . . . The balance which he keeps in his pocket is obviously worth more to him than the goods he sees with price tickets on them in the shop windows. This is because a cash balance gives a sense of power and security. It is kept available in case some unforeseen desire of more than usual intensity should chance to be roused." One cannot help feeling that some starting point such as this at the beginning of the book, showing money in its proper relation to a general theory of economic equilibrium, would have thrown the fundamentals of money into stronger relief than does the present opening in historical terms.

Mr. Houston's conclusions on the essentials of stability are temperate, and will probably command support as far as they go. "In general, the simple and obvious policy of stabilizing the average level of profits may be maintained without fear or favour. The profit index is the fundamental guide to the monetary requirements of the community, and all sectional interests must submit to the general

policy. . . ." The value of money "may vary upwards or downwards in response to genuine changes in the value of goods. It is for the authorities to see that it does not vary upwards or downwards in response to changes which are only connected with deficiency or excess in the quantity of money itself."

But does this take us very far? As a rough generalization, it will pass muster. But what does profit margin mean *in exact terms*? Is, for example, the average return on fixed capital always to remain constant in face of changes in the rate of new invention or of population growth? And, far more important, is the profit margin an indicator of policy which will be sufficiently sensitive for the purpose of monetary authorities? Why not, for example, watch an index of unemployment or of business activity or of bank clearings? After all, the real problem of monetary authorities is to look out for danger signals, and significant changes are likely to show themselves far sooner in those directions than they are in figures of average profits.

A. T. K. G.

5.—*The Problem of Credit Policy*. By E. F. M. Durbin. London: Chapman and Hall. 1935. 8½" × 5½"; 257 pp. 10s. 6d. net.

In this book Mr. Durbin analyses the various methods that have been advocated for ensuring stability in the economic world. The aim should be to avoid either inflation or deflation—but does this imply a stable price level, or a stable effective circulation, or stabilization of consumers' income? A stable price level, Mr. Durbin maintains, is impossible if it is obtained by the present mechanism of producers' credits and if the price level of factors other than capital is relatively slow to move. His argument is that since capital accumulation necessarily increases the physical efficiency of the factors of production other than new capital, with constant money prices for them, the rise in their average physical efficiency will cause a proportionate reduction in money costs, and hence, if prices are stabilized by an outflow of money from the banks, an increase, and a disproportionate increase, in the level of money profits. Taking the view that the demand for money to be spent in productive enterprise is determined by the level of money profits made throughout the system, the situation is bound to become rapidly and cumulatively inflationary. If this takes place during a period of growing technical improvement, there can for a time be a continued increase in production and an inflation of profits without an upward movement of prices, a situation which probably existed in U.S.A. prior to 1929. But this cannot continue indefinitely, as there is no reason to assume that the rate of invention will itself rise indefinitely as inflation proceeds. Inflation for stabilization purposes must be checked eventually if prices are not to rise; there will then be a clash between the interests of price stabilization and the maintenance of profit expectation, and dislocation will inevitably follow.

The second alternative is that put forward by Professor Hayek—namely, a constant effective circulation (*i.e.* *M.V.* to be constant). This also Mr. Durbin contends will not produce stability. During a

period of capital accumulation, involving a lengthening of the period of production and an increase of producers' balances, these will have been achieved either by the action of the producers themselves, if they retain part of their current turnover for this purpose, or by the transference of savings from consumers to producers, in exchange, not for goods, but for securities. In the former case the producers' action is deflationary. In the latter equilibrium will equally have been destroyed, for although Transaction Velocity will have been maintained, yet the amount of money spent on new physical capital will fall short of the money not spent on consumption goods by the value of the deposits accumulated. There is therefore a wastage of saving. Mr. Durbin holds the view that Professor Hayek has been led to a false conclusion because he fails to distinguish between the demand for new physical capital and the demand for money, including the demand for money to hold in respect of new commercial stages intercalated in the structure of production, but Mr. Durbin's own argument at this point is somewhat elliptical and not easy to follow.

The third method of achieving stability—namely, by ensuring stability of Consumers' Income, meaning thereby income per head and not total income—is that advocated by Mr. Durbin, and he analyses what would be the effects of this policy in the various conditions arising in a changing economy.

In the last section of the book he discusses what information and what procedure would be necessary to bring about this desideratum of a stable consumers' income. Some of Mr. Durbin's readers will probably find the chapter dealing with the indices of conditions needed by the banking authorities a welcome change from the highly abstract matter of the earlier sections, and there is much here that is interesting and suggestive. He proposes that bank accounts should be divided into personal, trading and stock exchange accounts. Obviously a far better conception of economic movements could be reached if bank clearances and balances were treated in this way, but, as Mr. Durbin himself recognizes, such a change in accountancy would not be easy of achievement, nor, even were it achieved, would the information be complete or easy of interpretation. Nevertheless, some such attempt to obtain more informative statistics than are at present available he regards as essential, but it is "only as an unsatisfactory beginning to a radically necessary undertaking" that he would defend the contents of this chapter.

Then the final question arises how the monetary authority should act on the information. Mr. Durbin holds the view that the central deficiency of the existing banking mechanisms is the inability to increase the effective circulation when deflationary influences are at work, and in more than one place in the book he stresses, it may even be held he over-stresses, the limited influence of a fall in the rate of interest on effective circulation and trade activity when prices and profit margins are moving. In an earlier section he upholds the view that there is no theoretical objection to the issue of free consumers' credits, but since this as a direct method is obviously impractical, he develops as an alternative a plea for reflation by the deliberate unbalancing of the Budget, the deficit to be financed by the issue of

new money, whilst the external value of currency should be left free to find its own level. This highly heterodox conclusion will naturally not commend itself to everyone, but Mr. Durbin certainly puts forward a closely reasoned argument to support his contention, though one feels it would have been strengthened if he had shown how the effects of this policy in the conditions he postulates would compare with the effects achieved in countries which have in fact unbalanced their budgets and have still notoriously failed to achieve reflation.

Only the main arguments of the book have been summarized here, though it touches on many other points that cannot be referred to in a review of this length. There is much discussion of the views of other economists, especially those of Professor Hayek. It is, that is to say, highly controversial in parts, but controversy and disagreement are essential to the progress of monetary theory. The chief weakness of the book, however, lies in not a possible disagreement with some of the conclusions but in the fact that Mr. Durbin does not always show a gift of lucid exposition on the more complicated points. This is particularly so in the first two chapters, which give a general theoretic discussion of certain monetary problems. It is possible that some readers may be discouraged by these early chapters, but if so they will be the losers. The rest of the book is valuable both because it attempts a comprehensive survey of different schools of thought and because it contains views which, though not likely to prove the last word on the subject, do open out new lines of approach to the most vital of all economic problems.

W. A. E.

6.—*British International Gold Movements and Banking Policy, 1881—1913.* By W. Edwards Beach. Harvard University Press; (London: H. Milford), 1935. 8½" × 5½", xiv + 218 pp. 10s. 6d.

The primary purpose of this book is an historical analysis of the relation of gold movements to British banking policy in the generation preceding 1914.

It starts with a chapter on the theory of International Gold Movements, of which it may be said that an exposition less eclectic and more definitely the author's own would have been more helpful. The summary of the views (often discordant) of a number of economists past and present gives less effective guidance in interpreting events than the formulation of a definite self-consistent theory. If the author's modesty deterred him from claiming authority for any theory of his own, he could at any rate appeal to the facts to support it (for if they did not he could presumably modify the theory). There follows a chapter on gold and currency movements, which is mainly statistical. The statistics are compiled from Customs and Bank of England figures of exports and imports of gold, from Mint reports, and other sources. The aim of assembling this material and working out the appropriate balances and averages was a praiseworthy one, calculated to save Professor Beach's fellow-economists much labour, if only his own calculations were reliable! But what are we to think of a statistician who in one table gives the net gold coin issued by the Mint in 1910 as £2,600,000 instead of

£22,600,000 and the net export of British gold coin in 1913 as £29,747,000 instead of £7,794,000 (besides two or three less flagrant errors)? These are not misprints since the erroneous figures are embodied in the consequential calculations.

Next comes a series of narrative chapters. Views and comments are collected from contemporary sources, and there results a useful and informative picture of the progress of events. Here also, however, there are inaccuracies. Quoting the Mint's statistics of gold coin held by Banks (p. 90), Professor Beach prints a column headed "exclusive of the Bank of England," in which he appears to have deducted *all* the gold in the Bank of England without observing that the Mint figures include only coin and not bullion. And there is nothing to show that this column has not been quoted from the Mint as well as the rest.

An economist who collects contemporary views from periodicals should remember that they ought not to be used uncritically. When Bank rate was raised in March 1910 (misprinted 1911) this was not the second but the fifth time in the history of the Bank that the rate had risen during that month. Professor Beach's own interpretation of the facts is sometimes rather superficial. To say that "the fluctuations in gold coin and Bank of England notes suggests that hoarding of currency in large denominations was occurring from 1892 to 1894" (p. 75) is surely to show a strange misconception of the habits of the English public. And it may be mentioned that the very moderate expansion in the note issue that took place in that period was compensated by the decrease in private bank note issues.

Professor Beach finds a tendency for imports of gold to increase during the prosperity stage of business cycles, and for exports to grow during depression (p. 170). This is rather an insecure generalization from a period comprising a little more than four cycles, of which one showed directly contrary results.

Nor is it true to say that there were no purchases of securities by the Bank of England to ease the market during depressions. The Bank's holding of Government securities rose from £32,000,000 at the beginning of 1894 to £44,000,000 in 1896.

The book is not without merit; it is the product of considerable skill and labour. And it is a matter for regret that its value should be impaired by these inaccuracies and other defects. R. G. H.

7.—*A Hundred Years of Joint Stock Banking.* By W. F. Crick and J. E. Wadsworth. London: Hodder & Stoughton, 1936. 9½" × 6½". Pp. v + 464. 15s.

From domestic workshop to trust, from brewer-banker to the "Big Five"—an amazing development for a century and a half! The two authors have spent, Mr. McKenna tells us in a Foreword, six years in compiling the story of how over a hundred banks have in the course of time combined and developed to produce the Midland Bank of to-day, and it has been time well spent. The large chart at the end of the book, giving the genealogical tree of the Midland, is almost bewildering, but the apparent complexity is dissolved as the history unfolds itself in the preceding pages.

A summary of modern banking history in 34 pages affords a guide through the detailed annals which occupy the rest of the book. The origins of the Midland are to be found in the provinces, and in seven chapters the various areas in which expansion took place are covered—"early banking enterprise in the Midlands," "extensions from Birmingham," "expansion into the North-West," "cotton banks," "the Wales Bank," "Yorkshire Amalgamations," "the East Midlands and Beyond." The ninth chapter deals with early joint-stock banking in London, and particularly with the London Joint Stock Bank and those other institutions which, by one way or another, came into the Midland, a process of consolidation dealt with in the following chapter. Next comes an account of "the welded whole," and the last two chapters, dealing with the affiliated banks in the north of Ireland and in Scotland, give brief accounts of the progress of banking in those regions. Finally, there are very acceptable biographical sketches of Thomas Leyland, a great historical figure in Liverpool banking, of Charles Geach, who may be said to have established banking in Birmingham, of George Rae, author of *The Country Banker*, and of Edward Holden, the engineer of the modern amalgamation movement.

The regional surveys set the history of banking against a background of industrial and agricultural development, thus making prominent the interdependence of industry and banking, and at the same time displaying the often-neglected truth that national vicissitudes do not affect all areas alike. The general course of events was everywhere similar. The rapid development of trade and industry that characterized the last half of the eighteenth century required the provision of financial facilities and, communications being everywhere poor, prominent men—manufacturers, brewers, drapers, and the like (even an innkeeper)—with funds of their own set up banks, issued notes, and discounted bills. There were 721 "country bankers" in 1810; very many had only confused knowledge of banking or even accounting, nearly all had only moderate funds and were confined to narrow spheres of activity within local industries. Over-issues of notes, too easy extensions of credit were common in the effort to meet the growing demands of trade, and casualties were frequent. The Act of 1826 permitting joint-stock banking in the provinces enabled the formation of stronger institutions, but many of them suffered from the same defects as the private banks—the scarcity of efficient managers and dishonesty on the part of officials. Restriction to narrow localities made the raising of sufficient funds difficult and poor communications hampered the supervision of branches. In the effort to meet trade expansion, and in particular to cope with seasonal requirements, overlending was almost universal, a weakness "which could only be overcome by concentration of varied economic associations within the sphere of operation of a single bank." So began the movement towards the combination of banks in order to associate lending districts with borrowing districts and to ensure that a bank should not be crippled by dependence on one industry that might be temporarily embarrassed.

Joint-stock banking was not possible in London till after the Act

of 1833, and in that year five such banks were formed. The London Joint-Stock Bank, later to amalgamate with the Midland, was established in 1836. With no right of note issue, those banks won popularity by promising to pay interest on current as well as on deposit accounts, while the private banks and the Bank of England only paid interest on any account in very exceptional circumstances. As the rate of interest fell, payment of interest on current accounts became burdensome, and was abandoned by the London Joint Stock Bank in 1851. Faced with great hostility from the private banks which refused them entry to the clearing house, and from the Bank of England which till 1844 prevented them from discounting bills under six months, the joint-stock banks developed a call-loan business and acted as agents for country banks and foreign houses. Most of them prospered, but the progress of trade required ever larger financial institutions, and the crisis of 1866 revealed the need for a banking system instead of a disorderly array of antagonistic units. Banks which could not grow were threatened with stagnation or decline, and so a consolidation movement set in which brought the Albion and Imperial Banks into the London Joint-Stock Bank. The London banks, except the National Provincial, had never sought country business and had only moderate branch extensions in the metropolitan area. But the great country amalgamations were feeling the want of balance in their structure and the need for operation in a metropolis no longer remote. This the Midland Bank achieved by union with the City Bank (1898), the Metropolitan Bank (1914), and the London Joint-Stock Bank (1918). Thereafter development took the form of a nation-wide system with a due proportion between borrowing districts and districts that accumulated funds; with this aim the Midland increased the number of its branches from 1444 (923 of which had been added by amalgamation) at the end of 1919 to 2110 at the end of 1934.

A word must be said in praise of the sketches of banking in the North of Ireland and in Scotland. The early adoption of the cash credit system put banking in Scotland on a sound basis and was a major factor in the industrial development of the country. The issue of one-pound notes and the institution of branches were other features. In 1826 31 banks had 139 branches and 10 new banks established between 1826 and 1844 had 180. "Scotland had thus quickly developed an advanced banking structure by evolving the principle of the bank with a widespread branch system at a time when England was still floundering in the mire of local banking on a mixed private and joint-stock basis." By the end of the nineteenth century the industries of Scotland and England were no longer separate, but were constituent parts of the consolidated economic structure of Great Britain, and thus their banking systems were brought closer together. The Scots banks had found the need for branches in London, and the size of the larger English concentrations raised questions of co-operation versus competition. Sir Edward Holden, developing "an advance in the technique of integration," secured the "affiliation" of the Belfast Bank in 1917, of the Clydesdale Bank in 1920, and of the North of Scotland Bank in 1924. In each case the entire capital of the company was acquired, but there

was no "fusion." "All three of them have preserved their names, their note issues and their own board of directors, and general day-to-day business is undertaken just as before; indeed, they exercise complete autonomy of administration. Nevertheless, the advantages of association are real and mutual."

With Mr. McKenna we may congratulate the authors "on the presentation of a living history." The authors have performed with great skill a work entailing immense labour. The telling of the story of local developments of banking inevitably involves much similarity of description, but dullness is avoided by adherence to the sound principle of keeping banking history in close touch with local industrial changes. The book is, therefore, a contribution to industrial history as well as a detailed and documented account of the evolution of banking in England. The student will be well advised to place this book (and Mr. King's *History of the London Discount Market*, reviewed below) on the same shelf with R. D. Richards's *The Early History of Banking in England* and Professor Gregory's *Documents relating to British Banking, 1832-1928*.

H. W. M.

8.—*History of the London Discount Market*. By W. T. C. King, Assistant Editor "The Financial News." London: Routledge, 1936. 8 $\frac{3}{4}$ " \times 5 $\frac{1}{2}$ ". xix + 355 pp. 15s.

In an Introduction to this book Professor Gregory commends the author in words which cannot be bettered: "He has carried out his self-appointed task supremely well and his book will take its rightful place as one of the indispensable tools of the student of British banking and currency." Yet in one respect this just verdict can be enlarged. It is commonly supposed that the study of Money is both difficult and dull, but it would be truer to say that the fundamental principles of monetary theory are simple, though their application is difficult and their emergence from a varying technique in the "money market" has been prolonged and accompanied by contention. When the subject is taken out of the text-books of theory and treated historically it can become alive and palpitating with interest, if the historian knows his job as Mr. King knows his. One reader, at least, is ready to proclaim that he found the book at all times fascinating and sometimes thrilling, and that after he had finished it—at only three sittings—he felt that he had a better comprehension than ever before not only of the development of the discount market, but also of the evolution of deposit banking and of the perfecting of Central Bank technique—three subjects which are inseparable. We shall now await with eagerness the book which Mr. King promises, "a practical and mainly descriptive work to show the modern discount market in perspective," and we urge him not to delay in completing his task.

Money-dealers who were intermediaries in bringing borrowers and lenders together were found in pre-Tudor times, and the chief of them were the "scriveners," who prepared business documents for merchants. Bills of exchange were centuries older, and the practice of discounting them grew, though up to about 1750 the intermediaries

worked chiefly between merchant and merchant. "When, however, with the beginnings of industrialization and the growth of trade banks grew up in districts where borrowers predominated, the services of the bill broker became indispensable." The lack of communications both imposed long terms of credit on sellers and forced banks to assume the "unit" form, so that the brokers, who alone had specialized knowledge of the standing of their customers, were alone able to satisfy the needs of the industrial areas for money by procuring the discounting of their bills with the London banks and the banks in agricultural areas. With the growth of banks in the country these were supplied with money by the re-discounting through the brokers of the bills which they had discounted for their customers. Thus arose, for example, the bill-broking firm which ultimately became Overend, Gurney & Co. The first half, and more, of the nineteenth century was marked by dissension between the private banks, the joint-stock banks, and the Bank of England, and the bill-brokers were continually involved in the controversies. The Bank of England had only intermittent glimmerings of its real position as a Central Bank, the responsibilities of the commercial banks were imperfectly felt, and monetary theorists were involved in a bog of partial reasoning, lighting their way by dim lanterns and sometimes following mere *ignes fatui*. We cannot here follow the events in detail, but it is worth noting that after the Bank Act of 1844 was supposed to have settled the control of the currency, the adoption by the Bank of Peel's opinion that "the banking business of the Bank should be governed on precisely the same principles as would regulate any other Body dealing with Bank of England notes," led to a policy of competitive discounting by the Bank which contributed largely to the crisis of 1847.

Meanwhile the banks had begun the practice of lending their surplus funds "on call" to the brokers, who were thus enabled to discount bills on their own account, and it was "quite well developed" by 1836. The brokers, in turn, in times of emergency rediscounted their bills with the Bank, treating it as the final reservoir and controller of credit. Competition by the Bank in discounts and advances ceased after 1847, but the reckless over-trading that followed the gold discoveries led the Bank to cease re-discounting in 1857 and to persist in their refusal for many years. It took several decades before the true principle of qualitative control of the bill market came to the surface. The introduction of the idea of limited liability of joint-stock companies, the progress of industry, the expansion of branch banking, the immense improvement in communications brought great changes, first the rise of the great discount companies, and secondly the gradual disappearance of the inland bill. The development of overseas trade brought with it the foreign trade bill and the creation of an international market. The old hostility between the commercial banks and the Bank gradually faded out, and under Lidderdale the Bank established a control of the money market, its moral supremacy being universally acknowledged. Such was the condition of things in 1914; after the War the Treasury Bill has largely displaced the foreign trade bill and, if international trade

is to continue to dwindle, the restriction of trading to Treasuries and short-term Government securities may well bring about, as Professor Gregory says, profound changes in the discount market.

The book evokes some general reflections. Looking back at the various "manias" that have swept the country, one is disposed to wonder whether those are not right who attribute industrial fluctuations mainly to "psychological" causes. The credulity of the public, the lust to get rich quick, throw unlovely lights on the "profit motive" so lauded in text-books. One is dismayed to read of the scandals and of the unholy crowd that preyed on the simple, and is tempted to declare that nothing good can come out of "the City," but the very strength of the forces of dishonesty shows that there must have been a central core of impregnable honesty, otherwise our monetary institutions could not have survived, let alone developed. The second point is that economic theory must be relative to economic structure. In Mr. King's history, we find imperfect theory partially applied and producing error; gradually the technique appropriate to current developments is hammered out on the anvil of experience; and theory then comes in to correlate techniques and produce a reasoned cosmos out of practice.

H. W. M.

9.—*Wages and Labour in the Lancashire Cotton Spinning Industry.* By J. Jewkes and E. M. Gray. Manchester University Press, 1935. 8 $\frac{3}{4}$ " \times 5 $\frac{1}{2}$ "; xiv + 222 pp. 8s. 6d. net.

It will be a great pity if this book is read only by persons directly interested in the cotton industry. As the authors say in their preface, "they are anxious to put before the general public, which is always perplexed by wage questions in the cotton industry, and students of wage theories, who must usually be content with highly abstract simplifications of the relation between capital and labour, an account of the manner in which the Spinning Wage Lists have grown up and of the fundamental issues which must be faced." Mr. Jewkes and Mr. Gray can rightly claim to have written the best book available on wages and labour conditions in the cotton-spinning industry, and it deserves to be read by those outside as well as those inside the industry.

The book is more restricted in its scope than its title would suggest. It deals mainly with the wages paid and the methods of paying them to the 65,000 operatives engaged in the operation of mule and ring spindles. Except in Chapter III, which deals with costs of production, it is not concerned with wages in the carding and preparatory processes of spinning, or in winding, doubling or other final processes in production of cotton yarn and thread. Of these 65,000 operatives, 50,000—mainly men and boys—are engaged in mule spinning and 15,000—mainly women and girls—are engaged in ring spinning. During recent years ring spinning has been gaining ground at the expense of mule spinning in Lancashire, and, as Mr. Gray and Mr. Jewkes say, "mule spinning is fighting a vital and on the whole a losing battle with ring spinning" (p. 149). It is therefore more important perhaps for the future that the method of paying wages to ring spinners should be the more

satisfactory and the weaknesses of the ring-spinning list more speedily remedied.

But as they are careful to state—again on p. 149—“it would be a disaster if the process of mule spinning, upon which Lancashire does and must largely depend, were adversely affected by the failure to provide the simplest and most efficient system of wage payment.” In mule spinning, the operatives usually work in teams of three, consisting of one minder of, say, 30 years or older, one chief assistant, called a big piecer, aged 18 to 30 years, and one junior assistant, called a little piecer, aged 14 to 18 years. Each team of three is responsible for two “mules,” each containing 800 to 1,400 spindles. The total wages of each team of three are fixed according to a collective piece rate, but it should be noted that the distribution of the total wages received among the three members of the team is in effect determined by the minders, and not by the employers. The wages of big piecers are abnormally low in comparison with adult male operatives in other industries, but it may be thought that a big piecer is in effect serving an apprenticeship to a minder. This, as the authors show, is not a correct analysis of the piecer problem. Big piecing has always been to some extent a blind-alley occupation, and, what is worst, the opportunities of piecers becoming minders have become less during recent years because of the depression in the industry.

The piecer problem is a serious one—so serious that the authors suggest the remedy lies in the extension of the Trade Boards Acts to cotton spinning. It may not be feasible to set up a Trade Board to regulate wage rates for one group of operatives in one section of the industry, but the figures given in support of their suggestion are striking. In 1933, the average full-time weekly earnings of adult big piecers—many of whom were married—were 27s. to 27s. 6d. in Bolton and 28s. 9d. to 32s. 6d. in Oldham, compared with standard unemployment benefit of 28s. per week. It is probably true to say that too small a proportion of the earnings of the “mules” goes to the big piecers and too large a proportion to the minders, and the piecers are apparently powerless to improve their position. They are allowed to be members of the same trade unions as the minders, but have no voting power, and attempts to form separate unions for piecers have failed. Mr. Jewkes and Mr. Gray discuss various suggestions for improving labour conditions in the industry—the employment of women as piecers, the replacement of women by men as ring spinners, the extension of the system of joiner minders. Although the present generation of minders must almost all have suffered the iniquities of the piecer system, there has been no spontaneous effort by the spinners’ unions to improve the position of the piecers.

Considerable interest will be shown in the results obtained in Chapter II, where the authors reach the conclusion (p. 24) that “For at least sixty years before 1920, it was true to say that earnings were rising more rapidly or falling more slowly than wage rates. This has not been true since 1920. The decline in full-time earnings between 1920 and 1932 was rather more marked than wage rates.” The statement seems to be so contrary to what might have been expected that the figures are worth quoting. Between March 1920 and

September 1932 wage rates in mule spinning fell from 134.2 to 100.0 and in ring spinning from 135.2 to 100.0. Over the same period full-time earnings in mule spinning declined from 138.5-138.9 to 100.0, and in ring spinning from 135.9 to 100.0.

This book is issued from the Economics Research Section of the University of Manchester, and is one of the series of investigations published by the Section during the last few years. Its success should encourage the authors to extend their enquiries to other sections of the cotton industry.

H. C.

10.—*Management Planning and Control*. By A. G. H. Dent. London: Gee and Co., 1935. 8½" × 5½"; xxii + 333 pp. 10s. 6d.

This book can be readily recommended to all those interested in business administration and scientific management. Mr. Dent has an intimate knowledge of management problems in manufacturing industry. A perusal of the bibliography at the end of the book shows that much of the literature on this subject is American. It is good to be able to welcome this new book on the subject based on English experience from one who is a Fellow of the Society.

Mr. Dent's book deals mainly with problems of budgetary control. "Budgetary control consists in a highly developed method of co-ordinated working to a plan of estimates, based on the fullest information available, interlocking these estimates into a budget and regularly checking up results against quotas set. . . ." It is obvious that in the application of this form of control statistical methods ought to play an important part. Statisticians will therefore look carefully at those chapters in the book which attempt to define the rôle the statistician ought to take in industrial administration. It is encouraging to read that many large firms are organizing efficient statistical departments.

Perhaps in his zeal for the wider introduction of statistical methods in problems of administration, Mr. Dent goes farther than many people would agree in his advocacy of methods of business forecasting. Many of his statements about the business cycle and the possibility of determining future trends are startling. "Some industries move slightly in advance of the main cycle, heralding its approach with a generous gesture to those watching those industries as warning indicators, but, unfortunately, failing to save themselves. Perhaps this is economic chance." Again, "Major cycles of prices tend to persist over long periods. These major price cycles are of about 40-50-year periods. Such a major cycle appears to have swung up from about 1885-90 to 1915-20, and is evidently on its down swing into the 1940 period." Perhaps the whole problem of the use of statistical methods in business forecasting is summed up in a quotation from an address by Mr. J. A. Crabtree which Mr. Dent gives on page 271. "Fundamentally I think the process of forecasting is really this. It is the process almost of absorbing into the mind all the facts of a situation, relating them to events in the past, and then I am sure that the mind itself jumps a stage, as it were, in a subconscious mind: it comes to certain conclusions, and you think you have worked these conclusions on a statistical basis, but really,

as a matter of fact, the mind itself has jumped to that stage." Now we know how it is done !

H. C.

11.—*Employment Research*. An Introduction to the McGill Programme of Research in the Social Sciences. By Leonard C. Marsh. London and Toronto : Oxford University Press, 1935. Pp. xviii + 344. 10s. 6d.

In 1931 the Rockefeller Foundation made a five-year grant to McGill University, Montreal, thus enabling the university to extend considerably its research into social science problems. It was decided to begin by concentrating on problems of employment and unemployment with special reference to Canadian conditions, and in addition to give detailed attention to the Montreal district. The volume before us is the first published result of the many "studies" undertaken, and in it the author (the Director of Social Research in the University) gives a preliminary survey of the various problems under investigation, dealing with some quite generally and with others in greater detail. Apparently thirty-two "studies" have been undertaken by the Director and his colleagues and assistants, and from the list of them given in the book practically every branch of this many-sided subject has been tackled. Immigration, nationality, education, quality of labour, health standards, labour supply and demand, seasonal fluctuations, female labour problems and investigations into individual industries and occupations.

Apart from the chapters dealing with the distribution of the working population, which are accompanied by various statistics and charts, the longest chapter in the book deals with seasonal and cyclical fluctuations. In Canada the importance of seasonal fluctuations is accentuated both by the extreme range of climate as between summer and winter and by the large proportion which the persons gainfully employed in agriculture bear to the total number of persons in Canada gainfully employed. This proportion is over 28 per cent., whereas in Great Britain the corresponding proportion is probably not 7 per cent. The extreme mechanisation which in Canada has been applied, wherever possible, to agriculture, and especially in harvesting processes, has tended greatly to reduce the demand for casual labour in this industry, but "workers who depend on the agricultural seasons can only rely on a few months' employment, even if they secure work on more than one type of crop." On the basis of the official index number of employment, it is stated that at least 10 per cent. of the workers employed in the months of maximum employment, August and September, are unemployed, *from seasonal causes alone*, in the winter. This index number does not cover agriculture, and relates to rather less than one million work-people in the major employments, but it would seem to be doubtful whether it is safe to apply such a high percentage to all employments and to firms of all sizes. The proportion unemployed in winter, however, in the building trade, in shipping, and in dock and riverside labour must be very high. We must await the publication of the various detailed "studies" for more definite information on these and other subjects dealt with by the Director. Statistics of

population covering about forty pages are given in the appendices, and an interesting attempt is made to classify the gainfully occupied population of Montreal city, according to skill and status, by the use of the wages returns in the Census of 1931. W. A. B.

12.—*Road and Rail in Forty Countries*. By Dr. Paul Wohl and Prof. A. Albitreccia. Oxford University Press, 1935. 9 $\frac{1}{4}$ " \times 6 $\frac{1}{2}$ ". xix + 453 pp. 18s. net.

In this country the combined efforts of the respective parties and the legislature to arrive at an equitable solution of the road and rail problem have, at any rate, brought about some abatement of the controversy. But there remain elements which require considerable elucidation before the terms of the relationship can be equated, particularly the degree of restriction to be imposed upon a form of transport which in the space of a few years has established itself intimately in our daily life, and as a consequence remains largely in the hands of individual operators.

The question was deliberated by the International Chamber of Commerce at its Washington Congress in 1931, and this work completes the report* of an investigation directed principally to the effect of the growth of road transport upon rail-borne goods traffic. It comprises a survey of the conditions of rail and road transport development throughout the world and an analysis of the descriptive data, which has been conveniently summarized in synoptic tables. The international viewpoint is emphasized and is fully justified by the emergence of features, both of the problem and its attempted solution, which are more or less common to countries at similar stages of economic development. Nothing in this study is more striking than the influence of the universal contraction of trade upon the established traffic systems. One of the chief difficulties is the allocation of the responsibility for railway losses between this factor and the more localized effects of road-transport evolution. The degree of competition between the two agencies naturally varies. In many cases the transport organism as a whole is undeveloped, particularly in China and Western Asia; in others, physical characteristics tend to favour either rail or road or a more or less natural combination, as in Belgium, where a dense railway network facilitates the employment of the road services as feeders and distributors. In India and Australia, where the railways are faced with almost chaotic conditions resulting from diversity of ownership, tariffs and operating methods, the fringe of the problem has been barely reached. Perhaps the greatest similarity is between Great Britain and the United States of America, where the severity of the struggle appears to have been greatest. But there are almost universal indications of a decline in the long-established supremacy of the railways and a corresponding slackening of government restriction.

The attempts at solution depend largely upon the nature of railway ownership, but action by the State has generally been directed

* An introductory report was published in November 1933. (Brochure No. 85 of the International Chamber of Commerce, Paris.)

towards definition of the functions of the respective types and/or their co-ordination. In one or two cases the knot has been cut and the railways have been given a virtual monopoly of goods transport. But there has been a widespread resort to the method of "concessions" with or without limited monopolies over certain routes and a tendency towards greater centralization of highway control. Efforts at co-ordination are by no means universal. The system of regional pacts in France, based upon *ad hoc* restriction of both forms, and set in motion last year, will be watched with interest. It appears at least to avoid the inherent disadvantages of large-scale amalgamations and what is generally understood by "rationalisation," even if the incentive of competition is lost.

In this country, as in many others, the railways have attempted to meet the situation by modernization of technical methods, extension of facilities and reduction of tariffs. It is hardly true (as stated on page 408) that in Great Britain "no general tariff reduction has been introduced." The "monthly return" or penny-a-mile ticket has been in operation since May 1933, and an increasing proportion of passenger revenue can be attributed to it. The principle of voluntary co-operation is actively in force as regards passenger traffic, and will no doubt extend to road-freight services as and when these become effectively organized. Restrictive road-transport legislation has been plentiful, and to some extent has been incidental to the remarkable progress of highway traffic. But the two principal measures, the Road Traffic Act of 1930 and the Road and Rail Traffic Act of 1933, appear likely to be adopted as models in many countries. There seems, however, to be at least some justification for the view taken in certain quarters that the tendency is towards railway monopoly, and how far this may be avoided or controlled by the somewhat diffuse constitution of the Transport Advisory Council, set up under the Act of 1933, remains to be seen.

In their preface, the authors express the hope that their work has not been in vain. Their impartial analysis of a controversy in which statistics have been widely maltreated cannot fail to be of considerable importance.

H. G. L.

13.—Other New Publications.*

Longobardi (Cesare). Land Reclamation in Italy: rural revival in the building of a nation. London: P. S. King, 1936. 8½" × 5¼". 243 pp. 12s. 6d. net.

[The term "land reclamation," in modern Italy and in this book, covers not only every kind of improvement of the soil itself and in the methods of its utilisation, but also the reorganisation of the whole agricultural system as the basis of a planned national economy—the "rationalisation," in fact, of agricultural production. Sir Daniel Hall is quoted as having called the Italian achievement in this field "the biggest bit of constructive work since the War ended," and the author states that the book was written in response to enquiries from people in many different countries. It consists partly of general exposition and explanation, including an entire chapter of speeches by the Duce, and partly of an objective account of what has been and is being done and of the legislative, administrative and

* See also "Additions to Library," p. 437.

financial methods employed in doing it; Chapter VII describes five specific examples of "reclamation." Two appendices give, respectively, the texts of the relevant Act and Decree. There are 29 photographic illustrations, but no index.]

Milbank Memorial Fund, Collected Papers on Research, 1934.
8 $\frac{3}{4}$ " \times 6".

[This volume contains the Fund's sixth annual report, and twenty-six papers under the following heads: Public Health Administration, Health and the Depression, Population, and Other Studies. In the first group are two studies of Tuberculosis, by Jean Downes and John Korns, respectively, and two on the Health Department Nursing Service, by Martin Randall. In the second group, with the exception of "Diets of Urban Families with Low Incomes, an Analysis of Weekly Food Budgets of 472 Families," by Dorothy Wiehl, all the papers are either by G. St. J. Perrott and Selwyn Collins, together, or by one or both in collaboration with Dr. Sydenstricker. These are: Sickness among the Depression Poor; The Economic Depression and Sickness; How Unemployment Affects Illness and Hospital Care; Changes in Family Income and Rental during the Economic Depression; and three reports on surveys, concerned with sickness and depression, of wage-earning urban families. The eight papers under the head Population (by various authors, including Professor Raymond Pearl and Dr. Frank Notestein) are concerned with such subjects as the effectiveness of birth control, sickness, unemployment, and differential fertility, family limitations, and pitfalls in sampling for population study, and include an interesting paper on the age and sex composition, marital conditions, birth- and death-rates, and rate of natural increase and future trends of the Chinese population, by Chi-ming Chiao. The last group, Other Studies, consists of a collection of papers on various medical subjects treated statistically. A list is given of other papers published by the Fund in 1934 not included in this volume.]

Narain (Brij). Tendencies in Recent Economic Thought. Delhi.
University Publications No. 5, 1935. 9 $\frac{1}{2}$ " \times 6". 213 pp.

[This book consists of ten lectures delivered in 1934 by the author (who is Professor of Economics at the Sanatana Dharma College, Lahore), as Sir Kikabhai Premchand Reader, to the University of Delhi. In his preface he disclaims any intention of summarising recent discussions on economic theory, and refers to the tendencies which form his subject as leading, the first, towards simplification, and the second, from individualism to collectivism. He also devotes attention to the "distinct American trend called Institutionalism," and to the development of Indian economic thought. Reversing the order in the preface, the first two lectures deal with these additional subjects. The first, on Indian economics, and the last, "The capitalist spirit and religion," will perhaps be the most interesting to English readers, in that they give a view of Indian problems from within, expressed by one who has evidently read widely and thought deeply. The other lectures discuss, with plentiful instances and quotations, the American trend, modern views of value, of rent and interest, and of the value of money, the world-wide trend of thought towards collectivism, and the present position of the theory of socialism. One great benefit conferred on the Indian student is that he is made acquainted with the content of various European publications which are, so far, not available in English.]

United States Department of Labor. Women's Bureau, Bulletin No. 135. The Commercialisation of the Home through Industrial Home Work. Washington, 1935. 9" \times 6". 49 pp. 5 c.

[The frustration, by competition from home workers, of efforts to raise factory wages and the failure to increase piece-work rates to home

workers as well as the now greater number of home workers (due to the unemployment of other members of the family) make the industrial home work problem of the United States a special concern to-day. The home work is divided into four categories: (1) Unskilled or semi-skilled handwork, (2) skilled work done entirely by machine or partly by machine and partly by hand, (3) skilled repetitive handwork having no art sales value, and (4) handicrafts having art sales value. To take a few of the occupations at random, the first category includes making artificial flowers, stuffing and stitching baseballs, making beauty and barber pads used in permanent waving, and decorating fancy-shaped candles; the second, making tailored clothes to measure, making by hand or machine fur jackets, muffs, collars and fur trimming; the third, mending hosiery and darning spaces missed by the machine in machine-made woollen cloth; the fourth, hand weaving baskets, making candlewick bedspreads, and embroidering children's dresses. We are given engaging pen-and-ink sketches of workers employed in some of these pursuits. One section of the book contains "silhouette" stories of some of the workers: a woman and "7 of her 11 children string tags. . . . Eight members working together can finish 5,500 shipping tags between 6 and 9.30 o'clock. This means 55 cents a night for their joint labors." The earnings of a family in Kentucky from chair-caning amounted in a year to \$85.45. In another family 15 and 20 hours of "lace pulling" by five adults produced \$1.34 each. A table of rates of pay and earnings is given. There are also short accounts of the efforts to protect the home worker and consumer by legislation, and the factory employee and employer by the abolition or regulation of home work by N.R.A. code agreement, with a description of the difficulties encountered, and a consideration of further steps to be taken.]

United States Department of Labor. Children's Bureau, Publication No. 215. Facts about Juvenile Delinquency. Its Prevention and Treatment. Washington, 1935. 9" x 6". v + 44 pp. 5 c.

[200,000 children pass annually through the State courts on delinquency charges, according to the estimate of the Delinquency Committee of the White House Conference of Child Health and Protection. The studies and reports which have been issued by this Committee have given rise to "a newer philosophy in regard to the whole problem of delinquency," and the object of the present publication is to present this newer philosophy in a non-technical and easily available form. It is maintained that "Society is paying too much for the care of criminals and too little for the prevention of crime," and preventive programmes to remedy this are outlined. They include assistance to parents in dealing with early behaviour problems, social work in the schools, and the study of community influence and leisure time activities. The agencies mainly responsible for the apprehension and treatment of delinquency (namely, the police, the courts, and the correctional institutions) are each separately discussed. Suggestions for further reading for the benefit of students of the subject are given after each of the various sections.]

STATISTICAL NOTES.

1. BRITISH OFFICIAL STATISTICS.

ON page 410 we give our usual table summarizing the oversea trade of the United Kingdom for the years ended March, 1935 and 1936. The excess of imports over exports of merchandise during the year 1935 amounted to £276 million. For the twelve months ended March, 1936, this excess was increased to £295 million. The increase in the adverse balance compared with the year 1935 is due to an expansion of £20 million in retained imports, exports of United Kingdom goods being substantially the same last quarter as a year earlier. It should, however, be noted that a year ago imports were abnormally low and exports abnormally high, and while the improvement in exports which has been in progress since the middle of 1933 was checked last quarter, the recent expansion in imports may well be followed at a later date by a further expansion in exports. Making comparison with the first quarter of 1934, also a period of relatively high imports, imports have increased by £16.6 million (9 per cent.), exports of United Kingdom goods by £11.4 million (12 per cent.) and re-exports by £1.0 million (6 per cent.).

In view particularly of the loss of our export trade to Italy, it is perhaps remarkable that over the two years exports should have expanded by a greater proportionate amount than imports, especially when it is appreciated that the volume of exports has risen by the same proportion as the value, viz. 12 per cent., while the increase in the volume of imports is only 3 per cent. as compared with an increase of 9 per cent. in value. Compared with a year ago, exports of United Kingdom goods showed no change in volume, imports increased by 8 per cent., and re-exports by $2\frac{1}{2}$ per cent.

Exports of British goods to Italy declined to £108,000 from £2,379,000 in the first quarter of 1935; this loss of trade particularly affected the coal industry, exports of coal to Italy declining by over £900,000. As a result of sanctions, imports from Italy also fell heavily from £2,028,000 to £59,000; in many directions supplies of goods formerly coming from Italy have been obtained from other sources, but this has not been possible in all cases, marble being the notable exception.

Total imports during the first quarter of this year were valued at £200,321,000 as compared with £178,419,000 a year earlier. Re-exports, amounting in value to £15,862,000, increased by

£1,950,000. Goods transhipped under bond, which are not included among the records of imports and re-exports, likewise increased—from £5,746,000 to £6,700,000.

The value of retained imports of food, drink and tobacco amounted to £85,751,000, being £6,570,000 more than in the first quarter of 1935. Meat was the only group for which a decline was recorded, there being smaller imports of each of the principal descriptions. The decline in imports of beef was small and there was a considerable increase in imports of cattle from the Irish Free State as a result of the coal-cattle agreement with that country. The principal increase was in grain and flour, retained imports of which rose in value by £2,469,000 (20 per cent.). The bulk of this was due to a rise in average values of imports of wheat and flour, though there was some increase in the quantity of all the principal descriptions of cereals imported, except oats, this increase being particularly marked in the case of barley and maize. Among dairy products, there was a substantial increase in imports of eggs, but declines for butter and cheese. Imports of sugar and tobacco were much larger than a year ago, and an increase of over 50 per cent. was shown in respect of cocoa.

Retained imports of raw materials rose by £7,461,000 to £51,797,000, increases being recorded for each of the groups except rubber and miscellaneous raw materials. For rubber there was a decline of £1,863,000 in imports and an increase of £687,000 in re-exports, imports a year ago having been abnormally high. Among the commodities showing increases may be mentioned, in particular, iron ore, tin ore, cotton, wool, silk, jute and copra.

An increase from £40,174,000 to £45,712,000 was recorded in retained imports of articles wholly or mainly manufactured. The only group to show a decline was silk yarns and manufactures. The increase was largest for manufactured oils (£1,186,000)—mainly due to larger imports of motor spirit—and machinery (£864,000), but an increase of over £500,000 was recorded for paper, cardboard, etc., and one of nearly that amount for iron and steel. Both imports and re-exports of non-ferrous metals were large in value, average values being in general much higher than a year ago, but over half the increase of £1,063,000 in imports was due to a fourfold expansion in imports of nickel.

Exports of United Kingdom goods during the first quarter were valued at £106,081,000, being £583,000 more than a year earlier.

An increase of £1,287,000 in exports of food, drink and tobacco, mainly due to larger exports of spirits and herrings, was balanced by a fall of £1,223,000 in exports of raw materials. Exports of coal were smaller in value by £894,000 and in quantity by 1,403,000 tons (15 per cent.), due essentially to the practical cessation of exports to Italy. Declines of 204,000 tons in exports to Spain, 113,000 tons in exports to Belgium and others of lesser magnitude were also recorded; the only increase of importance was the rise from 351,000 tons to 654,000 tons in exports to the Irish Free State. The quantity of wool exported was about 40 per cent. less than a year ago, the decrease being in exports to Germany; the decline in value (including woollen rags) was £674,000. The increase in exports of manufactures amounted to £553,000, under 1 per cent. The largest increases in value were recorded for machinery, miscellaneous textiles and miscellaneous manufactures, while there was a substantial fall of £648,000 in exports of vehicles, due to the value of new ships and boats exported declining from £1,220,000 to £226,000.

The expansion in exports of iron and steel goods which had been in evidence from 1933 to 1935 was not maintained during the first quarter of this year, when the total quantity exported (496,000 tons) was 28,000 tons (5 per cent.) less than in the first quarter of 1935. Pig iron, uncoated plates and sheets, and galvanized sheets all showed heavy declines; for finished goods in the aggregate there was no substantial change in the quantity exported. Exports of machinery increased by 1,700 tons. Agricultural machinery and electrical machinery continued the expansion recorded last year, and the decline in exports of textile machinery likewise continued. A further improvement in exports of locomotives and of motor cars and chassis was recorded, and exports of motor cycles were higher than in any quarter since the second of 1932.

Among textiles, exports of cotton yarns were the highest for four years, but piece-goods were 7 per cent. less than a year ago. Exports to India declined by 45 million square yards (25 per cent.), while exports to British West Africa rose by 20 million square yards, being nearly four times as large as two years earlier. The quantity of wool tops and woollen and worsted yarns exported showed a decline compared with the high figures of last year, but exports of woollen and worsted tissues and carpets continued to expand. Exports of artificial silk piece-goods rose by over 50 per cent., and substantial increases were also recorded for both linen and jute piece-goods, exports of linen piece-goods being the highest in any quarter for over ten years.

Movements and Classes.	Twelve Months ended 31st March, 1935.	Twelve Months ended 31st March, 1936.	Increase (+) or Decrease (—).			
Imports, c.i.f.—	£'000.	£'000.	£'000.			
Food, drink and tobacco	345,773	362,392	(+) 16,619			
Raw materials and articles mainly un- manufactured	204,609	220,791	(+) 16,182			
Articles wholly or mainly manufac- tured	171,889	191,230	(+) 19,341			
Other articles	3,829	4,426	(+) 597			
Total Imports ...	726,100	778,839	(+) 52,739			
Exports, f.o.b.—						
<i>United Kingdom Produce and Manufactures—</i>						
Food, drink and tobacco	29,842	32,927	(+) 3,085			
Raw materials and articles mainly un- manufactured	49,777	51,606	(+) 1,829			
Articles wholly or mainly manufac- tured	314,648	329,458	(+) 14,810			
Other articles	12,498	12,513	(+) 15			
<i>Imported Merchandise—</i>						
Food, drink and tobacco	12,456	12,427	(—) 29			
Raw materials and articles mainly un- manufactured	26,903	30,057	(+) 3,154			
Articles wholly or mainly manufac- tured	10,532	14,495	(+) 3,963			
Other articles	358	236	(—) 122			
Total Exports ...	457,014	483,719	(+) 26,705			
Bullion and Specie—						
Imports	187,881	274,470	(+) 86,589			
Exports	116,283	193,035	(+) 76,752			
Movements of Shipping in the Foreign Trade—	Number of Vessels.	Thousand Tons Net.	Number of Vessels.	Thousand Tons Net.	Number of Vessels.	Thousand Tons Net.
<i>Entered with cargoes—</i>						
British	24,059	35,732	24,483	36,815	(+) 424	(+) 1,083
Foreign	24,952	26,370	25,291	28,227	(+) 339	(+) 1,857
Total entered ...	49,011	62,102	49,774	65,042	(+) 763	(+) 2,940
<i>Cleared with cargoes—</i>						
British	28,281	33,666	29,359	34,283	(+) 1,078	(+) 617
Foreign	21,104	22,484	21,123	22,692	(+) 19	(+) 208
Total cleared ...	49,385	56,150	50,482	56,975	(+) 1,097	(+) 825

Imports of bullion and specie during the quarter amounted to £44.1 million and exports to £17.7 million, the import excess of £26.3 million comparing with one of only £0.5 million in the first quarter of last year, though for the full year the import excess was nearly £56 million.

The general level of *wholesale prices*, as measured by the Board of Trade Index Number, has shown but little change since the end of 1935. The index number for February, 1936, was 91.7 as compared with 91.8 for January, 1936, and 91.4 for December, 1935, a rise of 0.3 per cent. on December, 1935. Over the two months January and February food prices fell about 0.7 per cent. and the prices of materials and manufactures rose 0.75 per cent. Compared with February, 1935, the general index number showed a rise of 4.2 per cent. (articles of food 1.5 per cent., materials, etc. 5.4 per cent.). Among the group index numbers wool registered an advance of 21 per cent. over the twelve months, non-ferrous metals 13.3 per cent., textiles other than wool and cotton 10.2 per cent., and coal 5.4 per cent. On the other side cotton showed a fall of 5.3 per cent. In basic materials there was an advance of as much as 13.4 per cent. Intermediate products advanced 4 per cent. and building materials 3 per cent. Since the end of 1935 there has been some seasonal decrease in certain articles of food, but bacon prices have advanced from 10 to 15 per cent., and the price of potatoes, though somewhat lower in February than in January, remained as high as 80 per cent. above the price in February, 1935. Iron and steel prices continue to advance steadily, as do most non-ferrous metals. The price of tin, however, has receded somewhat from the high prices current over most of the year 1935.

The index numbers for the last three months are given below.

AVERAGES FOR THE YEAR 1930 = 100.

	Total Food.	Total Not Food.	Total.	Basic Materials.	Intermediate Products.	Manufactured Articles.	Building Materials.
Dec. 1935	88.5	92.9	91.4	93.8	90.0	96.2	95.1
Jan. 1936	88.8	93.3	91.8	95.4	89.9	96.0	94.9
Feb. 1936	87.9	93.6	91.7	96.3	90.1	96.1	94.9
<i>Feb. 1935</i>	<i>86.6</i>	<i>88.8</i>	<i>88.0</i>	<i>81.9</i>	<i>86.6</i>	<i>94.3</i>	<i>92.2</i>
<i>Feb. 1934</i>	<i>84.3</i>	<i>91.9</i>	<i>89.2</i>	<i>93.3</i>	<i>88.9</i>	<i>94.9</i>	<i>93.3</i>

There has been a slight fall during the last two months in the index number for *working-class cost of living in Great Britain* prepared in the Ministry of Labour caused by the commencement of

the usual decline in the spring of the prices of food. The index number for food which stood at 131 on 1st January, 1936, was two points lower (129) at 1st March (July, 1914 = 100). At the same time some slight increase has taken place in the cost of clothing, but there has been no change in the index numbers for rent and fuel. The index number for rent, which now stands at 58 per cent. above the figure for July, 1914, has been gradually rising over the last ten years. In the beginning of 1926 it was 48 per cent. above the figure for 1914 and in 1930 53 per cent. The increase over the period is due to a great extent to the advance in rates, which have risen considerably, but some small portion of it may be the result of improved accommodation and of the de-restriction in some measure of certain classes of working-class dwellings. The general index number for all items of expenditure combined was 147 at the end of December, 1935, and 146 at the beginning of March, 1936. Compared with 1st March, 1935, when the number stood at 141 there has been a rise in the cost of living of $3\frac{1}{2}$ per cent. Prices of potatoes have continued steadily to advance since the autumn as a result of the poor crop of 1935.

There was the general decline in employment in January, 1936, following on the period of special activity at Christmas, and the number of unemployed persons on the registers of the Ministry of Labour Employment exchanges at 20th January, 1936, showed an increase of over 291,000 on the number at the middle of December, 1935. This seasonal increase was more considerable than is usually the case, but severe weather conditions had prevailed for some days at the date when the number was taken, with the result that many outdoor occupations were adversely affected. The numbers unemployed in the building trades, for example, increased by over 96,000, but by the end of February more than 76,000 of these had resumed work. On the whole, employment improved in February as compared with January to a greater extent than usual, but there was some falling off in the motor-vehicle industry, and in the distributive trades employment continued to decline. The rate of unemployment still remains very high in many important industries. It is as high as 48.6 per cent. in public-works contracting, 36.3 per cent. in port-transport, 35.6 per cent. in shipbuilding, 30.5 per cent. in the tin-plate trade and 29.5 per cent. in shipping. There has, however, been an appreciable improvement in shipbuilding during the last twelve months. The rate of unemployment in the insured trades in Great Britain and Northern Ireland was 15.4 per cent. in February, 1936, compared with 16.3 per cent. in January and 14.2

per cent. in December, 1935. In February, 1935, the rate was 17.5 per cent.

The total numbers on the registers of employment exchange in Great Britain for the last three months are given below.

Date.		Wholly Unemployed.	Temporarily Stopped	Persons Not- mally in Usual Employment	Total.
16th Dec. 1935	...	1,585,990	205,574	77,001	1,868,565
20th Jan. 1936	...	1,732,503	345,117	82,102	2,159,722
24th Feb. 1936	...	1,677,077	259,292	88,652	2,025,021
25th Feb. 1935	...	1,840,136	353,548	91,779	2,285,463

The number of boys and girls aged 14 and under 16 on the registers at 24th February, 1936, was 69,967, of whom 24,726 were stated to belong to the insured trades.

According to the latest figures published by the Registrar-General, the total *population* of England and Wales is estimated to have amounted to 40,645,000 persons as at the middle of the year 1935. The figure is some 693 thousand in excess of the number enumerated at the Census of 1931, and thus indicates an average rate of growth over the four post-censal years of 0.43 per cent. per annum following an average for 1921-31 decennium of 0.55 per cent. per annum. Of the total increase of 693 thousand, 493 thousand is to be accounted for by the excess of births over deaths, leaving 200 thousand to be ascribed to the miscellaneous movements summed up in the term migration; the latter appears to have been inward on balance, since about 1930, after having been almost consistently outward in character over a period of several decades.

Though it can be and has been demonstrated that the birth rates experienced in this country in recent years are definitely insufficient ultimately to maintain an increasing or even a stationary population, the current excess of births over deaths, viz., 130, 84, 121 and 122 thousands in the respective years 1932 to 1935, is sufficiently high and persistent to suggest that the peak of the population growth is not likely to be reached within the next decade; while if, at the same time, it is permissible to associate the change in the direction of migration with causes which have also contributed to the recent phase of the birth-rate decline and to assume that the effect of a continuance of the low birth-rate will be offset, so far as the numerical magnitude of the population is concerned, by a continuance of the inward

migration tendency, the attainment of the peak position may well be delayed for 20 years or more.

The *marriages* provisionally announced for 1935 number 348,312, or a rate, in terms of persons married, of 17·1 per 1,000 population. The rate is in excess even of the high rate of last year (16·9), and with the exception of the two somewhat special post-war years 1919 and 1920, is higher than any recorded since 1873. It may be compared with 15·9 as the average for the four years 1931-34 or with 15·5 as the average of the decennium 1921-30. The maintenance of the marriage rate at or above pre-war levels has been a surprising feature of the economic depression, and though a comparison based upon crude marriage rates alone may be slightly distorted owing to the declining proportion of children in the population, even when this factor is eliminated it is necessary to go back well into the nineteenth century to find marriage frequencies of the present-day level.

Live births registered during 1935 numbered 599,167, corresponding to a rate of 14·7 per thousand population. The number is slightly greater than that recorded last year, but the rate, owing to the increase in population, is 0·1 lower, so that the present rate level would have been the lowest on record but for the minimum of 14·4 per thousand which was recorded in 1933. Amongst available contemporary records, it would appear that other countries in which recent birth rates have fallen below the 15 per 1,000 level are Austria, Sweden and Norway, the rates in Austria and Sweden being lower even than those of England and Wales. On the basis of population stability adopted by the Registrar-General, the standard number of births required to maintain stationary population conditions in the future would, when expressed in relation to the present population of the country, be represented by a crude birth rate of about 19½ per 1,000. This level has not been reached since 1923, and as the current rate is only three-quarters of this standard, the inevitable consequence must be that unless there is a substantial increase in the near future or a wholly unexpected influx of immigrants, future population growth in this country will tend to be at an ever diminishing rate, and will ultimately be converted to a decline. The sex incidence of the births of 1935 is represented by the proportion of 1,056 males per 1,000 females.

The *deaths* registered in 1935 amounted to 477,371, which, in terms of total population, represents a crude death rate of 11·7 per 1,000. As with the births, the number is slightly higher, but the rate fractionally (0·1) lower than that of 1934. The rate is only 0·3 per 1,000 above that of 1930, which is the lowest on record for this country. The infant mortality rate, *i.e.*, the deaths under 1 year of age per 1,000 births, was 57 in 1935, as compared with 59 in the previous year, and takes the place of that rate in constituting the minimum hitherto recorded in this country; the rate may be compared with 72 and 100 as the averages for the decennia 1921-30 and 1911-20 respectively.

The latest available age rates are those for the year 1934 recently published in Part I of the Registrar-General's Statistical Review for that year, and are as follows, comparative figures being added for the quinquennium 1926-30 :—

Annual Deaths per 1,000 Population in each Age-group.

Age (last birthday).	1934.		1926-30.	
	Males.	Females.	Males.	Females.
0-4	19·3	15·6	23·2	18·5
5-9	2·5	2·4	2·5	2·3
10-14	1·4	1·4	1·6	1·5
15-19	2·4	2·2	2·6	2·4
20-24	3·1	2·7	3·2	3·0
25-34	3·2	3·0	3·7	3·3
35-44	5·1	4·1	6·2	4·7
45-54	10·9	7·7	11·7	8·4
55-64	23·3	16·4	24·0	17·7
65-74	55·6	42·0	59·7	46·0
75-84	129·3	103·9	137·6	114·0
85 and over	256·4	230·6	293·6	275·3
All ages Standardized *	10·4	8·3	11·5	9·3

* On basis of 1901 population of England and Wales.

Return No. 193 of the Ministry of Transport gives particulars of the traffic carried during the month of December, 1935, with statistics of operation for the four weeks ended 28 December. Aggregate figures are held over until the publication of the Annual Returns. The improvement in revenue was maintained, passenger receipts for the month at £3,712,000 representing an increase of 2·0 per cent. over the corresponding period in 1934, and freight receipts at £7,441,000 an increase of 8·3 per cent. In addition, the railway undertakings of the London Passenger Transport Board record takings of £480,300, which were 6·2 per cent. above those of December, 1934.

Passenger journeys totalled 104,132,000 (to which the London Passenger Transport Board's lines contributed 35,538,000), an encouraging feature being an increase in workmen's journeys, this figure having risen by 917,000 to 24,486,000. First-class travel, although constituting only 1·3 per cent. of the total, appears to be regaining support, the number of journeys, at 1,360,000, representing an increase of 242,000 or 21·7 per cent. A decline of 2·0 per cent. in parcels traffic is attributable to a reduction in rates necessitated by the Post Office concessions in July last. The total tonnage of goods carried during the four weeks was 21,859,000, an increase of 4·3 per cent., and ton-miles rose by 7·4 per cent. to 1,239,700,000, the average distance hauled having advanced by 2·9 per cent. to 56·71 miles.

Additional operating expenditure is indicated by increased engine mileage. Coaching miles were 24,424,000 or 1·7 per cent. higher, and freight miles advanced by 4·8 per cent. to 19,244,000. The average wagon load at 5·72 tons and the number of wagons per train at 34·73 show slight increases, resulting in an improved average train load of 132·6 tons, as compared with 127·1 tons for the corresponding period in 1934. The operating results were, however, badly affected by the severe weather shortly before Christmas. Train miles per hour fell from 15·0 to 14·7 for Coaching trains and from 8·9 to 7·9 for Freight trains, and ton-miles per engine-hour decreased by 4 per cent. to 432·7. Climatic conditions must also take responsibility for an increase of nearly 3 lbs. per mile in coal consumption by locomotives, which rose to 56·1 lbs., and it is probable that this alone added about £50,000 to the cost of operation.

Gross receipts have continued to improve during the current year. The rate of increase has remained fairly constant and the position up to 17 May was as follows :—

	Receipts.		Increase on 1935.	
	£	£	Per cent.	
Great Western	9,026,000	209,000	2·4	
L.M.S.	21,978,000	751,000	3·5	
L.N.E.	16,175,000	491,000	3·1	
Southern	6,969,000	40,000	0·6	
Total	54,148,000	1,491,000	2·8	

2. OTHER STATISTICS.

The index numbers of wholesale prices prepared by the *Statist*, the *Economist* and *The Times* also show little change since the end of 1895, that of the *Economist* (1927 = 100) receding from 71.4 at the end of December to 70.9 at the end of February, 1936, and that of *The Times* (1913 = 100) from 107.5 to 106.4, while that of the *Statist* (1866-77) has remained stationary at 86.7. The official index numbers of wholesale prices for France, Germany and the United States and the British index numbers are given below, the average prices for 1913 being taken as 100 for all the index numbers except that of the Board of Trade.

Date.	Board of Trade (1931 = 100).	<i>Economist</i> .	<i>Statist</i> .	<i>The Times</i> .	France (<i>Stat. Générale</i>).	Germany (<i>Stat. Reichsamt</i>).	United States (Bureau of Labor).
Dec. 1935	91.4	98.2	102.0	107.5	357	103.4	115.6
Jan. 1936	91.8	98.1	102.0	107.0	364	103.6	114.9
Feb. 1936	91.7	97.5	102.0	106.4	377	103.8 ?	115.1
<i>Feb. 1935</i>	<i>88.0</i>	<i>91.3</i>	<i>98.1</i>	<i>100.8</i>	<i>349</i>	<i>100.9</i>	<i>113.9</i>
<i>Feb. 1934</i>	<i>89.2</i>	<i>90.6</i>	<i>97.1</i>	<i>100.8</i>	<i>384</i>	<i>96.2</i>	<i>105.4</i>

It will be noticed that over the last two years wholesale prices have advanced in the United Kingdom, Germany and the United States, and have declined in France, though not to any great extent.

The appreciation in the value of *Stock Exchange Securities* has been fairly continuous since the autumn of 1935, when there was a sharp fall at the time of the most acute stage of the Abyssinian crisis. The rise has been most noticeable in the case of variable dividend securities, and the index number prepared by the *Bankers Magazine* showed an advance in February, 1936, of $5\frac{1}{2}$ per cent. since December, 1935, and nearly $12\frac{1}{2}$ per cent. since September, 1935. At 18th February, 1936, the index number (126.7) for these securities (December, 1921 = 100) was higher than at any period since October, 1930. The index number for fixed interest stocks (131.0) is not quite as high as in the early months of 1935, but is higher than at the end of the year, and nearly $5\frac{1}{2}$ per cent. above the figure for September. There have been over the last two months very sharp advances in the prices of copper shares (27 per cent. since December, 1935) following on marked earlier advances, and considerable advances in British railway shares both ordinary and preferred, and also in rubber, in iron and steel shares, and in United States railway shares.

The index numbers (December, 1921 = 100) for the last three months are given below.

Date.	Fixed Interest Stocks.	Variable Dividend Securities.	Total
16th Dec., 1935	129.5	120.1	126.4
20th Jan., 1936	130.1	123.9	128.1
18th Feb., 1936	131.0	126.7	129.6
<i>19th Feb., 1935</i>	<i>131.6</i>	<i>113.7</i>	<i>125.8</i>

Shipping-freight rates declined in January and February from the high rates obtained in December, 1935, when the average rate (22.49) as shown by the Chamber of Shipping index number (1920 = 100) was higher than in any month since November, 1929. A fall of 5.7 per cent. in January, 1936, was followed by a further fall of 7.3 per cent. in February, when the number stood at 19.66. The average rate for the latter month, however, was 14.2 per cent. above that for February, 1935, when the index number was as low as 17.22. The recent drop in rates appears to be chiefly due to the absence of grain cargoes for shipment from South America. Rates are still more than 20 per cent. below the average for 1929, and the Government's subsidy for tramp shipping has been continued for another year. The minimum rates schemes agreed on for certain voyages appear to be fairly well observed.

The statistics of *retail sales* in Great Britain prepared by the Bank of England and the Association of Retail Distributors show that for February, 1936, there was an increase in the value of the sales of 7.3 per cent. over those for February, 1935. Sales of grocery, food and perishables increased 8.6 per cent. and other sales 5.5 per cent. The largest increase was in Southern England (8.2 per cent.) and the smallest (4.5 per cent.) in London (Central and West End). Over the twelve months February, 1935–January, 1936, the value of the sales increased 6.5 per cent. over the period February, 1934–January, 1935, and there was an increase of 3.3 per cent. in the latter period over the preceding twelve months. Taking the average daily sales in 1933 as 100, the index number for 1934 was 103 and for 1935, 109. For food the numbers were 103 and 111, and for other merchandise 103 and 108. Over the same two years the Ministry of Labour index number of the prices of food of working-class consumption rose only about 2.4 per cent., and though the sources of these two sets of figures are not at all points comparable

the increase of 11 per cent. in the value of retail sales over the period indicates that there has also been a considerable increase in the quantities of food sold.

Employment in the Irish Free State has continued slack, but is on the whole not very different from a year ago. Nearly 142,000 persons were on the registers of the Employment Exchanges at the end of February, 1936.

In most European countries employment shows little change except for the usual seasonal improvement in the spring. In France, though the numbers on the registers of Employment Exchanges show little change, the results of the special monthly investigation indicate a small improvement. This investigation, which started in 1931, records the changes in employment in mining, industrial, transport and commercial undertakings which employ at least 100 workers as compared with the corresponding month a year previous. In February, 1936, for the first month since the investigation started, the numbers employed show an increase as compared with a year ago, the monthly figures from January, 1931, to January, 1936, having all shown decreases. In Germany the number unemployed at the end of February were 2,515,570, or about 27,000 more than in January, but 300,000 less than in February, 1935. On the whole employment was somewhat better than a year ago in Belgium, Austria and Poland and somewhat worse in Czechoslovakia and Holland. In the United States employment was better than at the beginning of 1935, but the American Federation of Labour has estimated the number unemployed in January, 1936, at 12,626,000 of whom 3,672,000 have been engaged on various emergency and relief schemes. In January, 1935, the number was estimated at 13,058,000. In Canada and New Zealand employment has improved appreciably. No information as to employment in Italy has been available since September, 1935.

CURRENT NOTES.

THE Institute of Economics and History, Copenhagen, have undertaken, in co-operation with the Amalgamated Society of Retailers, a series of "Statistical Investigations into the Economy of Retailing" and Bulletin No. 1, *The Grocery Trade*, by C. Lind, is an interesting attempt to analyse retailing costs, etc., for a sample of grocery shops in Copenhagen and suburbs. The material available for this report related to 1932 and consisted of returns for 84 shops only, or about 5 per cent. of those enumerated at the census of 1925. While the author considers the sample unrepresentative of Copenhagen grocery trade in general, he has grouped the shops concerned in various ways, by size of sales, by rate of stockturn, by size of gross margin, etc., and believes that the smallness of the resultant samples does not prevent them from revealing real tendencies towards variation in costs, etc., according to the factors thus isolated. Opinions may vary regarding the validity of the actual figures for any given group, especially when they are based on returns from two or three shops only. The real interest of such an investigation lies in the evidence it affords that independent retailers' records can be collected, in spite of the known reluctance of traders to divulge information regarding their accounts; and also that such records are susceptible of statistical analysis, in spite of the frequently alleged peculiarity of each single business. Tables of retail grocery costs for a few other countries are given for comparison with the Danish results, and reveal how little is known of distributive expenses, the United Kingdom being, unfortunately, one of the countries for which the information is so scanty as to be useless. Mr. Lind and the Institute of Economics and History, Copenhagen, both deserve thanks for their efforts to throw some light on the problems of retailing in Denmark, and for the careful and cautious analysis to which the available material has been subjected. They were fortunate in having the co-operation of the Amalgamated Society of Retailers and the Grocery Union, whose lead similar associations in other countries might well follow with benefit to the efficiency of their own trades.

The report of the Calendar Committee (*Journal*, 1935, Pt. II, p. 382) pointed out that the regular sequence of Sabbaths would be preserved in a calendar using intercalary weeks. Mr. D. R. Springall of Glasgow published such a calendar in 1931 with the title "Perpetual International Calendar (Leap Week)."

The Agricultural Economics Society has decided to offer two annual prizes of £10 and £5 respectively for essays on subjects connected with the economics of agriculture. Competitors must be either students at recognized institutions or holders (of not more than two years standing) of degrees and/or diplomas in agriculture and/or economics. Essays for the current year must be sent in by the 31st March, 1937, and must be on one of the following subjects:—

(a) Recent developments of methods of transport in their influence upon agricultural conditions.

(b) "There is no such subject as Agricultural Economics, any more than there is Cotton Economics or Mining Economics. The term only means a special application of Economic Theory to Agriculture."

(c) The organization of British farming in relation to the progress and future development of farm mechanization.

(d) Changes in the value of the agricultural output in Great Britain in relation to the number of persons employed and the earnings of the employees.

(e) "The stimulation of consumption rather than the restriction of supplies must be the basis of British agricultural policy."

(f) The future of producer-control under the Agricultural Marketing Acts.

Further particulars of the conditions can be obtained from the Honorary Secretary, The Agricultural Economics Society, University of Reading, 7 Redlands Road, Reading.

THE Indian Statistical Institute has from the beginning contemplated the possibility of including in its functions the holding of examinations for the award of certificates and diplomas in statistics, and in April 1935 the Council appointed a Standing Committee to consider the steps to be taken for instituting such examinations. A draft scheme, prepared by Professor P. C. Mahalanobis, Secretary of the Committee and Honorary Secretary of the Institute, was submitted to a number of eminent statisticians in India and Europe (among the latter being the late Professor Karl Pearson, Professor Egon Pearson, Professor Bowley, Dr. Wishart, Dr. Corrado Gini, and Dr. Zahn), and their comments were taken into consideration in the drafting of the Committee's final Report, which came before the Council of the Institute on December 16th, 1935. Although the Council's final decision was deferred to a later meeting, the Secretary was authorized "to take the necessary steps provisionally

in accordance with the recommendations of the Committee" to hold the first examination.

The Society has received several copies of this Report, which consists of 24 quarto pages and contains the full text of the proposed regulations for examinations in statistics, with explanatory paragraphs, an account of the Committee's appointment and procedure, comments received from the advisers referred to, and a brief historical sketch of the development of the use and study of statistics in India. It is explained that the recent increase in the demand for trained computers and statisticians makes it important to establish authoritative standards of proficiency, and that the main object at present is to set up "minimum standards in the actual practice of statistical computation and statistical analysis." Certificates will be in two groups—Computers' certificates and Statisticians' Diplomas. Computers' Certificate, Part I, will be suitable for junior statistical clerks in government offices, institutions or businesses; Part II will include most of the standard methods required for the analysis of statistical data. The Statisticians' Diploma, Part I, is intended for officers and research workers who wish to acquire a general knowledge of modern statistical methods, including the application to their own particular subjects; Part II will involve a more advanced knowledge of mathematical statistics, including the theory of probability and the theory of sampling distributions, and will be suitable for those intending to undertake statistical research or to work as professional statisticians in charge of laboratories or departments. Admission to Associate Fellowship of the Institute will be based primarily on research work, supplemented if necessary by an examination.

The Report ends with an extract from the *Proceedings* of the Council of December 16th last, in which they authorized preparations to be made for the holding of the first examination for Computers' Certificate, Part I. They further accepted the recommendation of the Committee that the Indian Universities should be approached with a view to their introducing Statistics as an independent subject in the examinations for the B.A., B.Sc., M.A., and M.Sc. degrees, and resolved that the Inter-University Board be requested to take action accordingly.

We learn with much regret of the death of Miss B. Leigh Hutchins, which took place on October 17th, 1935.

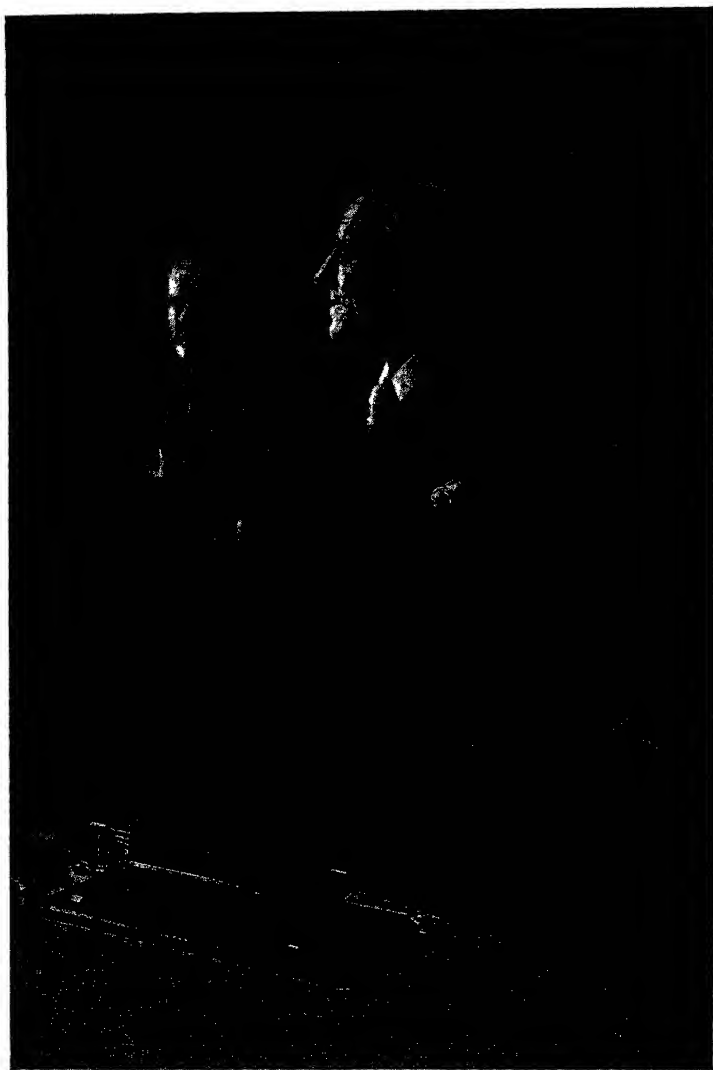
Miss Hutchins joined the Society in 1902. For many years she took an active part in its work, and was a frequent donor to the library. In 1909 she read a paper before the Society on Statistics

of Women's Life and Employment, the discussion on which was opened by Sir Charles Dilke, from the Chair, and contributed to by Mrs. Ramsay MacDonald, Miss Gertrude Tuckwell, and others well known in the women's movement. Miss Hutchins also contributed various short papers to the *Journal*, on subjects connected with industrial employment of women, its relation to their general well being and its social and economic effects on family life.

OBITUARY.

PROFESSOR KARL PEARSON, F.R.S., 1857-1936.

THOUGH Francis Galton, his hero and the Founder of the Chair which he occupied until 1933, was a Fellow of our Society from 1860 until his death in 1911, Karl Pearson never joined our ranks. But it is impossible to pass in silence the death of one to whom statistical science owes so much and to whose teaching the Society has been indebted for a number of its most active members, amongst them two Presidents. His direct contributions to our *Journal* number only two: a short paper written in conjunction with Dr. Alice Lee and Dr. Ethel M. Elderton *On the Correlation of Death-rates* (*Journal*, vol. lxxiii, 1910, pp. 534-539), which deals with methods of evading the supposed difficulty created by "spurious correlation" in discussing the relation between death-rates from two different diseases, and a *Letter to the Editors of the Journal* in the following volume (vol. lxxiv, 1911, pp. 221-229), commenting on views expressed by Professor Marshall and Mr. J. M. Keynes with regard to Eugenics Laboratory publications on *The Influence of Parental Alcoholism on the Physique and Ability of the Offspring*. But, besides these, two or three of his earlier papers, published by the Royal Society, were reprinted in the *Journal*. The Abstract of his first statistical memoir, of which the subject (not conveyed by the title) was the dissection of a compound-normal frequency distribution, will be found in vol. lvi, 1893, pp. 675-679. This is of some special historical interest, as it gives, in fuller form than in a footnote to the memoir itself, his formula for a skew curve based on the binomial series, work that was not fully and formally communicated to the Royal Society till a year later. His *Note on Reproductive Selection* will be found in vol. lix, 1896, pp. 398-402, and a short paper on *Telegony in Man* in vol. lx, 1897, pp. 440-449. These seem now a rather odd editorial selection. The fundamental memoir of 1895 on frequency curves and that of the following year in which the theory of correlation was developed do not appear to have received editorial attention—there were then no convenient "Current Notes"—though the former was discussed by Edgeworth in an article *On some Recent Contributions to the Theory of Statistics* (*Journal*, vol. lviii, 1895, pp. 506-515). To Pearson we owe not only the initial impulse to the whole development of statistical theory during the past forty years—and Pearson owed *his* impulse to Galton—but large and important contributions to the theory of frequency curves, the great bulk of the theory of correlation and



PROFESSOR KARL PEARSON, F.R.S.
1857-1936.

many methods derived therefrom or cognate thereto, and important contributions also to the theory of sampling : and all this theoretical work was illustrated by—often, indeed, derived in relation to—practical problems that served to drive it home : Pearson was seldom the abstract theorist. It is too early to judge his work with entire objectivity. Time will surely and inevitably sift the more from the less valuable, as it deals with the work of every man, but his life and labours will always remain the mark of a new epoch on the history of our subject.

The following memoir by Mr. G. Udny Yule is reprinted by kind permission, with some slight corrections and amendments, from *Nature* of May 23.

With Prof. Karl Pearson, who died suddenly on April 27, has passed one of the great figures of the last half-century in science. He was born in 1857, son of William Pearson, K.C., of sturdy Yorkshire stock. Educated first at University College School, he entered King's College, Cambridge, as a scholar in 1875, and took his B.A. (Mathematical Tripos, 3rd Wrangler) in 1879; he was elected a fellow of the college in the following year, and remained a fellow until 1886. In 1882 he was called to the Bar in the Inner Temple, and originally intended to make the law his profession. But Sir Alexander Kennedy persuaded him to give up law and, to use his own expression, "finally landed me in Clifford's chair of Applied Mathematics at University College"—the Goldsmid professorship of applied mathematics and mechanics in University College, London. This was in 1884. He was the spiritual, not the direct, successor to Clifford, who had died in 1879; the post had in the meantime been held by Prof. Henrici.

In this chair Pearson lectured not only in the varied subjects required by candidates for University of London degrees in arts and science, but also gave lectures to engineering students, with accompanying classes in the drawing office, on graphic methods applied to mechanics, the determination of stresses in structures and so forth. There was, I believe, no similar course held in any British engineering school at that time, except possibly by Prof. Henrici at the then Central Technical College. During these early years, Pearson completed and edited, at the request of the syndics of the Cambridge University Press, Todhunter's *History of the Theory of Elasticity* (1886-93), the request having apparently been made to him, as he stated in some recent recollections (*Math. Gazette*, Feb., 1936), owing to Todhunter having incorporated in his MSS. a portion of one of Pearson's papers for a Smith Prize.

Pearson had been keenly interested by the work of Francis Galton and his statistical ideas, and felt that here was a new field for mathematical treatment and advance. Measurements on crabs

made by his colleague Prof. Weldon presented an initial problem, and his first statistical paper was communicated to the Royal Society in October 1893 under the title "Contributions to the Mathematical Theory of Evolution," words used afterwards in the altered form "Mathematical Contributions to the Theory of Evolution" as a general title to many other memoirs. This paper dealt with the problem of dissecting a frequency distribution which could be assumed to be compounded of two normal frequency curves, and is important not only for its special subject but also for the introduction of the method of moments. This was followed in December 1894 (the dates given are those of communication to the Society) by the second memoir, "Skew Variation in Homogeneous Material," developing his now well-known system of frequency curves, and by the third in September 1895 on "Regression, Heredity and Panmixia," developing the theory of correlation with special reference to heredity.

The memoir by Pearson and Miss Alice Lee (June 1897) "On the Distribution of Frequency of Barometric Height, etc.," forms an interlude on a practical application; but with the fourth of the "Evolution" series (October 1897), "On the Probable Errors of Frequency Constants," written in conjunction with L. N. G. Filon, then his demonstrator but afterwards his successor in the chair, the first stage in the development of the Pearsonian *corpus* of statistical theory may be said to have been completed—frequency distributions, correlation, probable errors had all been given a first consideration. Truly astounding is the mass of work that followed, the more so when one remembers that it was not until 1911, when the Eugenics Record Office and its staff under Prof. Pearson's supervision had been already for some years in existence, that the will of Francis Galton made possible the endowment of the Galton professorship of eugenics, of which he inevitably became the first holder and with which his name is now chiefly associated; not until then was he able to drop the immense burden of lecturing necessitated by the duties of the Goldsmid chair. The first number of *Biometrika* was issued in October 1901, and it has now completed a nominal twenty-seven but actually twenty-eight volumes; a mere glance through the tables of contents will show how largely Pearson's own contributions bulk therein. But memoirs were still contributed to the *Phil. Trans.*, the *Phil. Mag.*—contributions to that magazine including the notable and much-discussed paper on testing goodness of fit—and elsewhere; and there was a whole host of Eugenics Laboratory Publications, as well as Drapers Company Research Memoirs; the Biometric Series, "Studies in National Deterioration," "Tracts for Computers," and "Questions of the Day and of the Fray," "K.P." was a born fighter, and the vigour of his onslaught not unnaturally led to retaliation in kind and

consequent heat; but any bitterness generated and not already dissipated by the passing years will not survive his death.

The "Technical Series" of laboratory publications also ought not to go without mention: the memoirs on stresses in hooks, on masonry dams, on metal arches and other subjects, witness to Pearson's continued interest in elasticity notwithstanding the new line of work. Of his scientific works in volume form, the *Grammar of Science* (1892 and later editions) exhibits admirably the originality and logic of his thought and the clarity of his exposition. *The Chances of Death and other Studies in Evolution* (1897) is an amazingly varied collection of essays on subjects as diverse as death, roulette, sociology and folklore. Finally, there is the monumental *Life of Francis Galton*, the finest tribute that could have been paid by the first holder of the chair to the founder whom he so honoured and loved. Though it scarcely falls within the category of his scientific writings, no one who wishes to know the man can neglect *The Ethic of Freethought* (1888, 1901), a collection of essays on history, philosophy and sociology.

Little more than two years ago Pearson described himself as "an adventurous roamer," and the phrase fits the man whose subjects ranged from Maimonides and the Veronica portraits of Christ to elasticity and statistics, and who could say: "In Cambridge I studied Mathematics under Routh, Stokes, Cayley and Clerk Maxwell—but wrote papers on Spinoza. In Heidelberg I studied Physics under Quincke, but also Metaphysics under Kuno Fischer. In Berlin I studied Roman Law under Bruns and Mommsen, but attended the lectures of Du Bois Reymond on Darwinism. Back at Cambridge I worked in the engineering shops but drew up the schedule in Mittel- and Althochdeutsch for the Mediæval Languages Tripos." The earliest contributions to the columns of *Nature* that I have traced—and he was a not infrequent contributor in older days—are a letter (February 9, 1882) on the similarity of descriptive adjectives applied to colours and sounds, and a second (July 24, 1884) on apparently intelligent behaviour by a jay! The variety of his work is as striking as its mass. Only a scion of such vigorous stock could have produced it, or could have continued producing to the end of so long a life.

No old pupil of his will ever forget the lucidity and originality of Pearson's lectures; as another of them has written in *The Times*, he was no text-book teacher. In point of fact, neither for the matter of his lectures to engineers nor for his lectures on statistics, in the early days at least, were there any text-books. His early students in statistics—and I have no reason to suppose that matters altered afterwards—often had the privilege of listening to the first tentative steps in work which afterwards took shape in memoirs. It is sometimes

said to the disadvantage of a non-resident university that there is little intercourse between teacher and taught, and little influence of the teacher beyond the classroom walls. Any such statement would be quite untrue of "K. P."; intercourse there was, the influence of his arresting and dominating personality went far beyond the classroom, and his tireless enthusiasm was infectious. Many of the makers and users of statistical methods all over the world to-day have been his pupils; more have learnt from his published work, and others again, as the years passed, have been pupils of his pupils.

Prof. Pearson actually gave his first public course of lectures in statistics, I believe, in 1893 at Gresham College, having held the Gresham Professorship of Geometry from 1891 to 1894. In 1896 he was elected to the fellowship of the Royal Society, and awarded the Darwin Medal in 1898. In 1903 he was awarded the Huxley Medal of the Royal Anthropological Institute and gave the Huxley Lecture *On the Inheritance in Man of Mental and Moral Characters and its Relation to the Inheritance of Physical Characters* (*Journ. Anthropol. Inst.*, vol. 33, and *Biometrika*, vol. III). In the same year he was elected an honorary fellow of King's College, Cambridge. He was an honorary LL.D. of St. Andrews, an honorary D.Sc. of London, and an honorary member of the Anthropological Societies of Paris, U.S.S.R. and Washington. In the Galton chair, which he resigned in 1933, he was succeeded by Dr. R. A. Fisher, but his son Dr. E. S. Pearson was appointed to a new professorship of statistics.

STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS.

UNITED KINGDOM—

Annals of Eugenics, December, 1935—Studies of a child population : *J. A. Fraser Roberts*, *R. M. Norman*, and *Ruth Griffiths*. The detection of linkage with "recessive" abnormalities : *R. A. Fisher*. A note on the specific gravity of the living human body : *F. Sandon*. The fiducial argument in statistical inference : *R. A. Fisher*.

Barclays Bank Monthly Review, February, 1936—Mr. W. Favill Tuke's address.

Bankers' Magazine—

February, 1936—The bank balance sheets. Credit and trade in 1935. Miners and mine-owners : *Frank Morris*.

March, 1936—Prime causes of unemployment : *A. H. Gibson*.

April, 1936—Poverty amid plenty : *John Brunton*. The American discount market : *F. A. Willman*. Argentine banking position : *H. Hallam Hipwell*.

May, 1936—The cheap money policy : *A. H. Gibson*.

East India Association, Journal, April, 1936—Our export trade with India—recent developments and possibilities : *Sir Thomas Ainscough*.

Economica, February, 1936—The theory of saving : *C. Bresciani-Turroni*. International trade in the absence of an international standard : *P. B. Whale*. French monetary policy : *R. G. Hawtrey*. The British Exchange Equalisation Fund : *F. W. Paish*.

Economic History, February, 1936—A college home-farm in the fifteenth century : *J. Saltmarsh*. Statistics of corn yields in mediæval England : *R. Lennard*. The exchequer bill in English government finance : *R. D. Richards*. Eighteenth-century traffic in live-stock : *G. E. Fussell* and *C. Goodman*.

Economic Journal, March, 1936—The United States Social Security Act : *Prof. Paul Douglas*. Legal rule and restraint of trade : *C. A. Cooke*. Utility analysis and interest : *Prof. F. A. Hayek*. Discriminating monopoly and the consumer : *Prof. W. H. Hutt*. Pareto's law : *Prof. D. H. MacGregor*. The Webbs on Soviet communism : *Prof. A. C. Pigou*.

Eugenics Review, January, 1936—German eugenics in practice : *Eliot Slater*. Recent literature on population problems : *David V. Glass*.

Institute of Bankers, Journal, February, 1936—The work of the London Bankers' Clearing House during the year 1935 : *Ernest Sykes*.

UNITED KINGDOM—Contd.

Institute of Public Administration, Journal, April, 1936—The traditions of the public services: Can they be extended to business?: *Sir Harold Bellman*. Public administration in Russia: *Prof. J. A. Prescott*.

Lloyds Bank Monthly Review—

February, 1936—Essentials of prosperity in France: *Frederic Jenny*.

March, 1936—The Indian market—its outlook and changing character: *Sir Alfred H. Watson*.

April, 1936—The economic evolution of Soviet Russia, 1917–1936: *R. J. Truptil*.

May, 1936—The consequences of economic nationalism: *Lionel Robbins*.

Manchester Statistical Society, Transactions, Session 1934–35—Public finance in China: *E. W. Mead*. Some interesting features in connection with railway statistics: *Ashton Davies*. Housing the people: *Norman McKellen*.

Midland Bank Monthly Review—

January–February, 1936—The development of monetary principles and practice. A century of progress: *Rt. Hon. R. McKenna*.

April–May, 1936—The budget of painful necessities.

Ministry of Agriculture, Journal—

April, 1936—A Cotswold experimental dairy farm: *Blanche Lee Godfrey*.

May, 1936—Unemployment insurance for agricultural workers. Tuberculosis in a dairy herd: *William Lawson*. Crop estimation and forecasting: indications of the sampling observations on wheat: *F. Yates*.

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South African Journal of Economics, March, 1936—European population growth since Union. An analysis of the birth, fertility and death rates with reference to the future increase of population: *Hansi P. Pollak*. The sterling price of gold: *F. J. van Bijlron*. A note on the nature and significance of economic planning: *Prof. Edward Batson*. Are the gold mines overtaxed? a commentary: *R. L. Ward*. The change in the distribution of incomes in South Africa after the abandonment of the gold standard: *Prof. R. Leslie*.

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January, 1936—Annual survey of general economic theory: the problem of index numbers: *Ragnar Frisch*. Composite commodities and the problem of index numbers: *Wassily Leontief*. A note on distribution of income over time: *Gerhard Tintner*.

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February, 1936—Rules versus authorities in monetary policy: *Henry C. Simons*. The origin and development of the Public Utility Holding Company: *Norman S. Buchanan*. Retail Trade in the United States and Canada: *A. S. Whiteley*. Devaluation of the dollar in relation to exports and imports: *Arthur R. Upgren*. Barcelona "bills of mortality" and population, 1457-1590: *Robert S. Smith*. The commercial theory of credit: *S. E. Harris*.

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Social Research, February, 1936—100 per cent. money: *Fritz Lehmann*. Public expenditures and economic structure in the United States.

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FRANCE—

Bulletin de la Statistique Générale de la France, January–February, 1936—L'enseignement primaire en France depuis la guerre: *R. Rivet*.

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February, 1936—Productivité et chômage: *Alfred Sauvy*.

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April, 1936—L'espérance de vie à la naissance s'est accrue de 45% depuis 1830: *M. Moine*. Les profits 1929–1935 (Grande-Bretagne, États-Unis, France): *M. Lescure*.

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GERMANY—

Allgemeines Statistisches Archiv—

Part 3, 1936—Relative Wahrscheinlichkeitsfunktionen : Wilhelm Britzelmayr. Unzulänglichkeiten der Statistik des Krebses : August Busch. Das Problem "Eisenbahn und Kraftwagen" — Ausgangspunkt internationaler verkehrstatistischer Aufgaben : Prof. Otto Most.

Part 4, 1936—Gefüge und Entwicklung der Volkswirtschaft : Paul Bramstedt. Die Arbeitslosenstatistik : Dr. Adem. Der Stand der preisgeschichtlichen Forschung in Deutschland : Alfred Jacobs. Technische Erfahrungen bei der österreichischen Volkszählung 1934 : F. Hiess.

Archiv für Mathematische Wirtschafts- und Sozialforschung, Heft 1, 1936—Die Invarianz des Deckungskapitals gegenüber Sterblichkeitsänderungen : H. Munzer and K. Löer. Bevölkerungszahl und Gattenwahl : Otfrid Müttmann. Grundfragen der angewandten Wahrscheinlichkeitsrechnung und der theoretischen Statistik, insbesondere das Problem der reinen Gruppen (1) : Friedrich Böhm. Bemerkungen über falschen und richtigen Gebrauch der Mathematik im wirtschaftswissenschaftlichen Schrifttum : Wilhelm Lorey. Bowleys Grundzüge der mathematischen Ökonomik : H. v. Stackelberg.

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January, 1936—Die graphische Methode in der Mathematik der Invaliditätsversicherung : Günther Wünsche. Die Bedeutung der erblichen Krebsbelastung für die Lebensversicherung : Karl Freudenberg.

April, 1936—Versuch einer systematischen Darstellung der modernen Risikotheorie, Teil 2. Betriebswirtschaftliche Untersuchungen : Carl Boehm. Kleiner Beitrag zur Theorie der Versicherung anormaler Risiken : Heinrich Jecklin.

Deutsches Statistisches Zentralblatt, Part 8, 1935—Neue Erhebungen auf dem Gebiet der Forst- und Holzwirtschaft : M. T. Lorey. Sonderhefte des Instituts für Konjunkturforschung, No. 40—Die Elastizität der Deutschen Getreide-Anbauflächen : Carl Boehm.

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GERMANY—Contd.

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Journal de la Société Hongroise de Statistique—

No. 4, 1935—Malthus and the population problems of to-day: *C. Balás*. La statistique internationale des migrations intérieures: *A. Kovács*.

No. 1, 1936—Élasticité et changeabilité économiques: *Th. Suranyi-Unger*. L'influence des emprunts extérieurs sur le mouvement des prix et les échanges internationaux: *Z. de Ovari-Papp*. Image statistique d'un État dont le territoire est composé avec harmonie: *A. Ronai*.

ITALY—

Bollettino di Notizie Economiche, February, 1936—Aspetti della situazione economica dell'Italia.

Economia—

January, 1936—Il petrolio e la politica del carburante: *Pier Lodovico Bertani*.

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January, 1936—Le industrie tessili italiane e le "sanzioni": *Giorgio Mortara*.

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March, 1936—La disciplina corporativa della produzione con particolare riguardo all'agricoltura: *Arrigo Serpieri*. Lo sviluppo demografico dei maggiori centri urbani italiani dalla fondazione del regno ad oggi: *Ugo Giusti*. Via delle Indie e via dell'Italia: *Giorgio Mortara*.

Le Assicurazioni Sociali, January-February, 1936—L'assicurazione contro la tubercolosi per i mezzadri e i coloni: *Bruno Biagi*.

JAPAN—

Kyoto University Economic Review, December, 1935—The pivot of local finance reform: *Prof. S. Shiomii*. An early history of the gold exchange standard in Japan: *Prof. K. Matuoka*.

SWEDEN—

Ekonomisk Tidskrift—

Part 6, 1935—Pris- och kostnadsdifferentiering : *Ivar Sundbrom*.

Part 1, 1936—Om ekonomisk välfärd och om kausaliteten vid ekonomiska företeelser : *David Davidsson*.

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February, 1936—Wheat outlook of the world : *Alonzo E. Taylor*.

March, 1936—Can the gold block learn from the sterling block's experiences? : *Bertil Ohlin*.

April, 1936—The changing significance of the Stock Exchange : *Leo Grebler*.

Skandinaviska Kreditaktiebolaget, April, 1936—Monetary prospects : *Prof. Gustav Cassel*. The Swedish steel industry of today : *H. Dahlerus*.

INTERNATIONAL—

International Labor Review—

February, 1936—Land settlement in Brazil : *R. Paula Lopes*. Alien workers in France : *Georges Mauco*. The scientific organisation of a department store and its effect on industrial relations: the "Globe Stores" at Zurich.

March, 1936—Housebuilding, the business cycle, and State intervention, I : *Leo Grebler*. The abolition of unemployment in the U.S.S.R. : *Boris Markus*.

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International Review of Agriculture, March, 1936—Agricultural protectionism and the agricultural situation 1925-1929 (to be continued) : *A. Emanuel*.



LIST OF ADDITIONS TO THE LIBRARY.

Since the issue of Part I, 1936, the Society has received the publications enumerated below :—

I.—OFFICIAL PUBLICATIONS.

(a) United Kingdom and its several Divisions.

United Kingdom—

General Register Office—

Census of England and Wales, 1931.—Counties of: Devon (Part II) 18 pp. 1s.; Yorkshire, East and North Ridings (Part II). 35 pp. 2s.; Derby (Part II). 21 pp. 1s.; Suffolk (Part II). 19 pp. 1s.; Cambridge, including the Isle of Ely and Huntingdon (Part II). 16 pp. 1s. The Registrar-General's decennial supplement, England and Wales, 1931, Part I. Life tables. 53 pp. 3s.

[London: H.M.S.O., 1935-36. 13" × 8½".]

Health, Ministry of—

Housing. Summary of the principal provisions of the Housing Acts and Public Health Acts in relation to the maintenance of dwelling-houses in a reasonably fit condition for human habitation. 8 pp. 2d.

Housing Act, 1935. Memoranda: A. General. 19 pp. 4d.; B. The prevention and abatement of overcrowding. 30 pp. 6d.; C. The redevelopment of overcrowded areas. 11 pp. 2d.; D. Financial provisions. 8 pp. 2d.; E. Consolidation of housing contributions and accounts. 24 pp. 4d.

Standardization and Simplification of the Requirements of Local Authorities, Second report of the Committee on. 36 pp. 6d.

[London: H.M.S.O., 1935. 9½" × 6".]

Imperial Shipping Committee. Report on rates of freight in the trade from the United Kingdom to New Zealand, 1935. London: H.M.S.O., 1935, 9½" × 6". 33 pp. 6d.

Overseas Trade, Department of—

Reports: 632. Lithuania, November, 1935. viii + 38 pp. 9d. 633. Union of South Africa, October, 1935. vii + 77 pp. 634. Southern Rhodesia, Northern Rhodesia and Nyasaland, October, 1935. viii + 74 pp. 1s. 3d.

[London: H.M.S.O., 1936. 9½" × 6".]

Trade, Board of—

Import Duties Act Inquiry (1933), Part II. The iron and steel trades, the engineering and vehicles trades, the non-ferrous metals trades, the timber, paper, clay and building materials trades and a general summary. London: H.M.S.O., 1936. 9½" × 6". xii + 262 pp. 4s.

(b) Dominions, Colonies, and Protectorates.

India—

Bombay Labour Office—

General wage census. Part I. Perennial factories, Second report. Report on wages, hours of work and conditions of employment in the printing industry in the Bombay Presidency (excluding Sind), May 1934. iii + 92 pp. 9d.

Report on an enquiry into wages, hours of work and conditions of employment in the retail trade of some towns of the Bombay Presidency. vii + 99 pp. 5d.

(b) Dominions, Colonies, and Protectorates.

India—Contd.

Report on an enquiry into working-class family budgets in Bombay city.
44 pp. 3 annas.

[Bombay, 1935-36. 9½" × 6".]

Punjab. Board of Economic Inquiry. Publications: 29. Rates of food consumption by 71 families of tenant-cultivators in the Khanewal Tahsil, Multan district. x + 193 pp. Rs. 1.8; 44. Family budgets, 1933-34, of six tenant-cultivators in the Lyallpur district . . . ii + 43 pp. 6 annas.

[Lahore: 1935. 9½" × 6".]

Punjab. Irrigation Research Institute. Report for the year ending April 1935. Lahore, 1935. 10" × 7". 74 pp.

Australia—

Health, Department of. Service publication no. 40. International hygiene. Canberra, 1935. 9¾" × 6". 112 pp.

Victoria. Centenary Council—

Victoria. The first century. An historical survey. Melbourne: Robertson and Mullins, 1934. 8¼" × 5½". 462 pp. 12s. 6d.

The official centenary guide and souvenir. Issued with the authority of the Council. 9¾" × 6". 223 pp. 1s.

Canada—

Statistics, Dominion Bureau of—

British Commonwealth Statisticians, 1935, Conference of. Report and resolutions adopted by the second Conference of Government Officers engaged in dealing with statistics in the British Commonwealth of Nations. Ottawa, 1935. 9¾" × 6½". 49 pp.

Canada, 1936. Official handbook of present conditions and recent progress. Ottawa, 1936. 8¾" × 5½". 196 pp.

Trade and Commerce, Department of—

Census of industry. Mining, Metallurgical and Chemical Branch. The automobile parts and accessories industry in Canada, 1934. Ottawa, 1935. 11" × 8½". 11 pp.

Census of industry. Paper-using industries in Canada, 1933. Ottawa, 1935. 9¾" × 6½". 99 pp. 25 c.

Manufacturing industries of Canada, 1933. Summary report. Ottawa, 1936. 9" × 6". 127 pp. 25 c.

Seventh census of Canada, 1931. New Brunswick. Census of agriculture. Ottawa, 1934. 9½" × 6½". civ + 65 pp. 25 c.

Irish Free State—

Census of production, 1934. Preliminary figures. Brewing industry. Tobacco industry. Malting industry. Dublin, 1935. 13" × 8". 1 p. each.

* (c) Foreign Countries.

Austria—

Vienna. Magistrat der bundesunmittelbaren Stadt Wien. Abteilung 47. Statistik. Die Ergebnisse der Erhebung der Wohnungsverhältnisse in Wien am 22 März 1934. Wien-Leipzig, [1935]. 12" × 8". 253 pp.

Brazil—

Ministerio da Agricultura. O Mate (Exploração, industria e exportação.) Rio de Janeiro, 1935. 9" × 6½". 92 pp. + 6 maps.

Bulgaria—

Sofia. Statistical Institute for Economic Research. Publications nos. 2-3, Sofia, 1935. 10¾" × 8¼". 279 pp. 70 leva.

(c) Foreign Countries—Contd.

Denmark—

Département de Statistique. Recensement général de la population, 5 novembre 1930. Copenhagen, 1935. 11½" × 9½". 313 pp. Kr. 4.00.

Finland—

Finlands Officiella Statistik. XXXII. Sociala specialundersökningar. 13. Undersökning rörande Arbetarungdomen. Helsingfors, 1935. 10½" × 7½". 38 pp.

France—

Statistique Générale de la France. Résultats statistiques du recensement général de la population, 1931. Tome I. Partie II. Population présente totale. 128 pp. Tome I. Partie III. Population active, établissements. 199 pp.

[Paris, 1935. 10¾" × 8½".]

Germany—

Statistisches Reichsamt. Statistik des Deutschen Reichs. Band 475. Die Finanzwirtschaft der öffentlichen Verwaltung im Deutschen Reich (Ausgaben, Einnahmen, Personalstand und Schulden) für das Rechnungsjahr 1932-33 mit Hauptergebnissen für das Rechnungsjahr 1933-34. Berlin, 1936. 12" × 8½". 435 pp. 15 Rm.

Hungary—

Office Central de Statistique. Recensement général de la population en 1930. Partie III. Résultats détaillés sur les professions et statistique des établissements. Budapest, 1935. 10½" × 7½". xviii + 261 pp. 6 pengos.

Poland—

Office Central de Statistique. Statistique de la Pologne, Série C—
Fasc. 26. Deuxième recensement général de la population, 1931. Les immeubles et les bâtiments dans les villes. xxii + 154 pp.
Fasc. 28. Statistique des cartels en Pologne. viii + 92 pp.
Fasc. 31. Prix des terres en Pologne 1933. viii + 26 pp.

[Warsaw, 1935-36. 11½" × 8¼".]

Switzerland—

Bureau Fédéral de Statistique. Contributions à la statistique suisse : Fasc. 3. Statistique des études supérieures en Suisse. 62 pp. Fasc. 4. Tables de mortalité de la population suisse. 83 pp.

[Bern, 1935. 9¾" × 6¾".]

Bern. Beiträge zur Statistik der Stadt. Heft 16. Der Berner Bau- und Wohnungsmarkt um die Jahreswende 1932-33. Bern, 1934. 8¼" × 5¾". 83 pp.

Turkey—

Office Central de Statistique. Population de la Turquie, 1935. Recensement général de la population par provinces, districts, villes et villages. Publication no. 74. Ankara, 1935. 10¾" × 8". 40 + xvii pp. + 5 charts.

United States—

Census, Bureau of the. Children under institutional care and in foster homes, 1933. 125 pp. 15 c.

Children's Bureau. Publication 215. Facts about juvenile delinquency, its prevention and treatment. v + 44 pp. 5 c.

Education, Office of—

Bulletins—

3. Parent education opportunities. viii + 52 pp. 10 c.

4. Compulsory school attendance laws and their administration. vii + 96 pp. 10 c.

5. Bibliography of research studies in education, 1933-1934. xiv + 328 pp. 25 c.

(c) Foreign Countries—Contd.

Education, Office of—Contd.

Bulletins—

7. Co-ordination of effort for the education of exceptional children. vi + 82 pp. 10 c.
8. Private proprietary and endowed schools giving trade and industrial courses. 91 pp. 10 c.
14. Federal student aid program. 39 pp. 5 c.

Pamphlets—

62. Legislation concerning early childhood education. 2 pp. 5 c.
63. The education of native and minority groups. A bibliography, 1932-34. 25 pp. 5 c.

Vocational education bulletins—

161. Rehabilitation series. Organization and administration of a state program of vocational rehabilitation. vii + 58 pp. 10 c.
47. Agricultural series. Summaries of studies in agricultural education. An annotated bibliography of 373 studies in agricultural education with a classified subject index and a general evaluation. 196 pp. 15 c.

Federal Trade Commission—

- House document 152. Report . . . on the sale and distribution of milk products. 1935. viii + 105 pp.
- Report . . . with respect to the basing point system in the steel industry. November 1934. iv + 125 pp. 10 c.
- Textile industries: Part II. The cotton textile industry. 34 pp. Part IV. The silk and rayon textile industry. v + 37 pp. Part V. Thread, cordage, and twine industries. ii + 9 pp. 5 c. each. 1935.
- Labor Statistics, Bureau of.* Bulletin 615. The Massachusetts system of savings-bank life insurance. viii + 104 pp. 10 c.

Women's Bureau. Bulletins—

107. Technological changes in relation to women's employment. v + 39 pp. 10 c.
 108. The effects of the depression on wage-earners' families. A second survey of South Bend. v + 31 pp. 5 c.
 135. The commercialization of the home through industrial home work. 49 pp. 5 c.
 136. The health and safety of women in industry. v + 23 pp. 5 c.
- [Washington, 1935. 9" x 6".]

California. Commercial Fisheries, Bureau of. Fish bulletins—

45. The sharks and rays of California. 66 pp.
46. A contribution toward the life histories of two California shrimps, *Crago franciscorum* (Stimpson) and *Crago nigricauda* (Stimpson). [Sacramento, 1935-36. 9" x 6".]

(d) International.

International Labour Office—

Studies and reports—

- Series G. No. 4. Recreation and education. Reports . . . to the International Conference on Workers' Spare Time. viii + 151 pp. 4s.
- Series K. No. 13. Studies on movements of agricultural population: II. The rural exodus in Czechoslovakia. iv + 170 pp. 5s.
- Series M. No. 13. International survey of social services, 1933. Vol. I. xv + 710 pp. 15s.
- [Geneva (London: P. S. King), 1935-36. 9½" x 6¼".]

(d) International—Contd.

League of Nations—

Economic and financial questions. Report submitted by the second committee to the Assembly. 13" x 8". 8 pp.

Economic Committee—

Considerations on the present evolution of agricultural protectionism. 10½" x 8". 49 pp. 1s. 6d.

Remarks on the present phase of international economic relations. 10½" x 8". 52 pp. 1s. 6d.

Survey of tourist traffic considered as an international economic factor. 10½" x 8". 47 pp.

[Geneva, 1935-36.]

International Labour Conference. Draft conventions and recommendation . . . 1935. London: H.M.S.O., 1935. 9½" x 6". 39 pp. 1s. 3d.

II.—AUTHORS AND MISCELLANEOUS.

Agricultural Economics Society, Journal of Proceedings. Report of Conference held . . . 28th June to 1st July, 1935. 9½" x 6". 83 pp. 5s.

Balás (Charles). Malthus and the population problems of to-day. Budapest: reprint from *Journal de la Société Hongroise de Statistique*, No. 4. 1935. 9" x 6". 39 pp. (From the author.)

Baudhuin (Fernand). La dévaluation du franc belge. Une opération délicate parfaitement réussie. Bruxelles: l'Edition Universelle. Paris: De Brouwer et Cie. 1935. 7½" x 5". 235 pp. 15 frs.

Boyd (Edith). The growth of the surface area of the human body. University of Minnesota, Institute of Child Welfare, monograph series no. X. Minnesota: University Press, 1935. 10" x 7". x + 145 pp. 22s. 6d.

Brace (James). A survey of the application of the principle of guarantee to building society loans. London: reprint from *Building Societies' Gazette*, November, 1935. 8½" x 5½". 8 pp.

Brenkman (C. J.), De Jong (G. H.), Neurdenburg (M. G.), Peters (H.) and Hoensen (H. W.). Diphtherie en actieve immunisatie met T.A.U. te Amsterdam en Rotterdam. Reprint from *Nederl. Tijdschrift voor Geneeskunde*, December, 1934. 9½" x 6½". 24 pp.

British Broadcasting Corporation. B.B.C. Annual, 1936. London: B.B.C., 1936. 9½" x 7½". 159 pp.

Brown (E. H. Phelps). The framework of the pricing system. London: Chapman and Hall, 1936. 8½" x 5½". xvi + 221 pp. 10s. 6d.

Building Industries National Council—

Special Committee for Public Relations. The building industries survey. Issue for October, 1935. London: The Council, 1935. 11" x 8½". Pp. 297-333.

Year book for 1936. Report on the work of the Council from its inception . . . London: The Council, 1936. 9½" x 6". 116 pp. 9d.

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REGISTRATION OF THE UNITED KINGDOM.

No. I.—ENGLAND AND WALES.

A.—Serial Table of BIRTHS, DEATHS and MARRIAGES, returned in the Years 1929–1935, and in the QUARTERS of those Years.

Calendar YEARS, 1929–1935 :—Numbers.

YEARS.....	1929.	1930.	1931.	1932.	1933.	1934.	1935.*
Births	643,673	648,811	632,081	613,972	580,413	597,642	599,167
Stillbirths	26,847	27,577	26,933	26,471	25,084	25,209	25,389
Deaths	532,492	455,427	491,630	484,129	496,465	476,810	477,371
Marriages	313,316	315,109	311,847	307,184	318,191	342,307	348,312

(I.) LIVE BIRTHS :—Numbers in QUARTERS of each Calendar Year, 1929–1935.

QUARTERS.	1929.	1930.	1931.	1932.	1933.	1934.	1935.*
Jan.—Mar. ...	160,047	158,545	159,663	152,116	148,597	149,396	146,530
Apr.—June ...	169,451	170,042	163,760	165,403	154,047	156,513	155,962
July—Sept. ...	163,777	165,596	161,133	156,186	147,959	149,224	155,615
Oct.—Dec.	150,398	154,628	147,525	140,267	129,810	142,509	141,060

(II.) STILLBIRTHS :—Numbers.

QUARTERS.	1929.	1930.	1931.	1932.	1933.	1934.	1935.*
Jan.—Mar. ...	6,878	7,069	7,091	6,883	6,684	6,453	6,471
Apr.—June ...	6,937	7,098	6,940	7,152	6,675	6,637	6,595
July—Sept. ...	6,569	6,850	6,568	6,283	5,902	5,979	6,300
Oct.—Dec.	6,463	6,560	6,334	6,153	5,823	6,140	6,023

(III.) DEATHS (excluding stillbirths) :—Numbers.

QUARTERS.	1929.	1930.	1931.	1932.	1933.	1934.	1935.*
Jan.—Mar. ...	204,309	131,967	162,208	153,451	169,983	146,003	132,648
Apr.—June ...	118,728	111,336	114,694	116,228	108,591	119,007	121,920
July—Sept. ...	96,749	96,389	96,735	97,984	95,810	97,469	100,060
Oct.—Dec.	112,706	115,735	117,993	116,466	122,081	114,331	122,743

(IV.) MARRIAGES :—Numbers.

QUARTERS.	1929.	1930.	1931.	1932.	1933.	1934.	1935.*
Jan.—Mar. ...	54,426	48,825	46,574	62,315	44,298	58,744	51,267
Apr.—June ...	75,488	88,138	85,380	68,968	85,597	84,956	97,961
July—Sept. ...	100,669	98,392	99,415	94,917	103,113	109,358	110,189
Oct.—Dec.	82,733	79,754	80,478	80,984	85,183	89,249	88,295

* Provisional.

*Annual Rates of BIRTHS, DEATHS and PERSONS MARRIED, per 1,000 PERSONS
LIVING in the Years 1928-1935, and in the QUARTERS of those Years.*

Calendar YEARS, 1928-1935 :—General Ratios.

YEARS.....	1928.	1929.	1930.	1931.	1932.	1933.	1934.	1935.*
Estd. Popln. } in thousands in middle of each Year	39,482,	39,607,	39,806,	39,988,	40,201,	40,350,	40,467,	40,645
Live Births ...	16·7	16·3	16·3	15·8	15·3	14·4	14·8	14·7
Stillbirths	0·70	0·68	0·69	0·67	0·66	0·62	0·62	0·62
Deaths	11·7	13·4	11·4	12·3	12·0	12·3	11·8	11·7
Persons Mar- } ried	15·4	15·8	15·8	15·6	15·3	15·8	16·9	17·1

(I.) LIVE BIRTHS :—*Ratio per 1,000, in QUARTERS of each Calendar Year,
1928-1935.*

QUARTERS.	1928.	1929.	1930.	1931.	1932.	1933.	1934.	1935.*
Jan.—Mar. ...	17·1	16·4	16·2	16·2	15·2	14·9	15·0	14·6
Apr.—June ...	17·4	17·2	17·1	16·4	16·5	15·3	15·5	15·4
July—Sept. ...	16·7	16·4	16·5	16·0	15·5	14·5	14·6	15·2
Oct.—Dec.	15·7	15·1	15·4	14·6	13·9	12·8	14·0	13·8

(II.) STILLBIRTHS :—*Ratio per 1,000.*

QUARTERS.	1928.	1929.	1930.	1931.	1932.	1933.	1934.	1935.*
Jan.—Mar. ...	0·72	0·70	0·72	0·72	0·69	0·67	0·65	0·65
Apr.—June ...	0·73	0·70	0·72	0·70	0·72	0·66	0·66	0·65
July—Sept. ...	0·67	0·66	0·68	0·65	0·62	0·58	0·59	0·61
Oct.—Dec.	0·68	0·65	0·63	0·63	0·61	0·57	0·60	0·59

(III.) DEATHS :—*Ratio per 1,000.*

QUARTERS.	1928.	1929.	1930.	1931.	1932.	1933.	1934.	1935.*
Jan.—Mar. ...	13·9	20·9	13·4	16·5	15·4	17·1	14·6	13·2
Apr.—June ...	11·7	12·0	11·2	11·5	11·6	10·8	11·8	12·0
July—Sept. ...	9·4	9·7	9·6	9·6	9·7	9·4	9·6	9·8
Oct.—Dec.	11·7	11·3	11·5	11·7	11·5	12·0	11·2	12·0

(IV.) PERSONS MARRIED :—*Ratio per 1,000.*

QUARTERS.	1928.	1929.	1930.	1931.	1932.	1933.	1934.	1935.*
Jan.—Mar. ...	9·2	11·1	9·9	9·4	12·5	8·9	11·8	10·2
Apr.—June ...	17·3	15·3	17·8	17·1	13·8	17·0	16·8	19·3
July—Sept. ...	19·0	20·2	19·6	19·7	18·8	20·3	21·4	21·5
Oct.—Dec.	15·9	16·6	15·9	16·0	16·0	16·8	17·5	17·4

* Provisional.

B.—Special Town Table :—POPULATION; BIRTH-RATE AND DEATH-RATE (Civilians) in each Quarter of 1935 in certain of the 121 Great Towns.

Cities and boroughs.	Estimated resident population mid-1934.	Annual Rate to 1,000 living during the thirteen weeks ending									
		Mar. 13, 1935. (1st quarter.)	June 9, 1935. (2nd quarter.)	Sept. 8, 1935. (3rd quarter.)	Dec. 27, 1935. (4th quarter.)	Births	Deaths	Births	Deaths	Births	Deaths
121 Great towns ...	20,815,634	14.8	13.2	15.5	11.7	15.3	9.2	13.7	11.6		
Including—											
London (Met. Bs.)	4,230,350	13.4	12.9	13.7	11.0	13.5	9.0	12.2	11.4		
West Ham C.B.	276,150	13.7	13.1	14.2	10.0	14.8	8.2	14.5	10.0		
Queensbury C.B.	132,000	13.7	13.2	14.2	10.0	14.8	8.2	14.5	10.0		
Brighton C.B.	142,000	13.4	13.0	14.2	10.0	14.8	8.2	14.5	10.0		
Portsmouth C.B.	248,000	13.4	13.0	14.2	10.0	14.8	8.2	14.5	10.0		
Bristol C.B.	410,500	13.9	13.1	15.1	10.4	14.1	8.4	12.3	11.3		
Cardiff C.B.	221,050	15.4	12.8	15.6	11.3	15.8	8.0	14.3	10.3		
Swansea C.B.	165,550	15.7	14.3	16.6	11.4	16.3	8.4	15.2	11.3		
Wolverhampton C.B.	110,300	13.9	13.6	17.1	10.0	17.0	8.4	15.2	11.8		
Birmingham C.B.	1,012,800	15.1	12.2	16.5	11.0	16.4	9.1	14.8	11.2		
Leeds C.B.	1,257,000	14.1	12.2	14.1	11.1	13.8	9.0	13.0	11.6		
Nottingham C.B.	281,800	14.6	12.7	14.7	11.7	14.5	9.5	13.1	11.5		
Derby C.B.	241,013	14.7	13.1	14.6	12.1	16.0	9.2	13.4	11.3		
Birkenhead C.B.	150,100	17.9	13.4	18.7	11.4	16.4	8.7	15.0	13.2		
Liverpool C.B.	816,840	20.7	15.0	21.1	12.5	20.6	10.7	18.7	14.4		
Bolton C.B.	176,200	12.6	15.4	14.0	12.3	12.6	10.1	11.8	13.9		
Manchester C.B.	754,200	15.1	14.0	15.3	14.1	15.4	10.1	14.2	13.7		
Salford C.B.	213,550	14.9	13.1	15.6	13.7	15.9	9.5	13.3	11.9		
St. Helens C.B.	135,200	11.7	19.9	13.3	14.4	13.6	11.1	11.2	14.7		
Widnes C.B.	91,300	13.5	11.4	13.3	11.4	10.5	12.0	14.7	13.6		
Blackburn C.B.	135,380	13.5	12.3	16.7	12.3	10.4	9.8	13.6	13.6		
Preston C.B.	117,450	15.3	14.6	15.2	13.1	15.7	9.6	13.0	14.5		
Huddersfield C.B.	114,500	11.7	15.7	13.8	13.5	12.1	10.5	11.3	15.0		
Halifax C.B.	97,050	12.2	15.5	13.1	17.5	12.1	11.4	10.6	12.8		
Bradford C.B.	293,650	13.8	16.0	13.8	15.8	14.1	11.1	12.3	13.4		
Leeds C.B.	480,250	14.7	14.5	15.4	14.0	14.8	10.7	14.4	13.6		
Sheffield C.B.	520,950	14.7	13.1	15.5	11.6	15.3	9.3	13.4	13.0		
Kingston upon Thames C.B.	164	13.6	18.0	18.0	13.1	18.0	10.1	15.6	11.2		
Stamford C.B.	358,600	14.1	14.0	17.7	13.6	15.1	10.4	17.6	13.5		
Gateshead C.B.	123,000	17.3	14.1	20.0	14.3	19.4	10.3	14.9	13.2		
Newcastle-on-Tyne ...	287,050	16.3	14.1	17.4	13.1	16.0	10.0	14.8	12.7		

† Excluding stillbirths.

Note.—The 121 great towns are those with populations exceeding 50,000 persons at the Census of 1931.

No. II.—SCOTLAND.

BIRTHS, DEATHS AND MARRIAGES IN THE YEAR ENDED
DECEMBER 31, 1935.

I.—Serial Table :—Number of BIRTHS, DEATHS AND MARRIAGES in Scotland, and their Proportion to the Population estimated to the Middle of each Year, during each Quarter of the Years 1931–1935 inclusive.

	1931.			1932.			1933.			1934.			1935.		
	Number.	Per 1,000.		Number.	Per 1,000.		Number.	Per 1,000.		Number.	Per 1,000.		Number.	Per 1,000.	
1st Quarter—															
Births ...	23,558	19.7		23,069	19.0		21,785	18.0		22,744	18.7		21,980	18.0	
Deaths ...	20,189	16.9		19,634	16.2		20,760	17.1		17,406	14.3		19,177	15.7	
Marriages ...	7,071	5.9		7,686	6.3		7,062	5.8		7,685	6.3		7,686	6.3	
2nd Quarter—															
Births ...	24,130	20.0		24,945	20.0		23,211	19.0		23,247	18.9		23,254	18.8	
Deaths ...	18,916	15.2		18,407	13.5		15,121	12.3		16,730	13.6		16,205	13.1	
Marriages ...	8,163	6.8		7,877	6.3		8,178	6.7		8,836	7.2		9,095	7.4	
3rd Quarter—															
Births ...	22,659	18.6		22,033	18.0		21,135	17.1		21,301	17.1		21,564	17.3	
Deaths ...	13,244	10.9		13,192	10.7		13,094	10.6		13,300	10.7		13,461	10.8	
Marriages ...	9,348	7.7		9,337	7.6		10,252	8.3		10,764	8.7		11,274	9.0	
4th Quarter—															
Births ...	21,873	17.9		21,653	17.6		20,415	16.5		21,544	17.3		21,125	16.9	
Deaths ...	14,880	12.2		16,812	13.7		15,883	12.8		16,305	13.1		16,488	13.2	
Marriages ...	8,080	6.6		8,257	6.7		8,719	7.0		9,634	7.7		9,908	7.9	
Year—															
Population	4,842,554			4,883,000			4,912,000			4,936,000			4,955,500		
Births ...	69,290	19.0		91,000	18.6		80,546	17.6		88,838	18.0		87,923	17.8	
Deaths ...	64,220	13.2		66,045	13.5		64,848	13.2		63,741	12.9		65,331	13.2	
Marriages ...	32,662	6.7		33,157	6.8		34,201	7.0		38,949	7.5		37,973	7.7	

II.—*Number of Births, Deaths, and Marriages in the 263 Large Burghs and Other Districts of SCOTLAND and their proportion to the population during each quarter of 1935.*

	Births.		Deaths.		Marriages.	
	Number.	Annual rate per 1,000 persons.	Number.	Annual rate per 1,000 persons.	Number.	Annual rate per 1,000 persons.
<i>1st quarter—</i>						
Large Burghs ...	12,469	18·7	10,808	16·2	5,065	7·6
includ- { Glasgow ...	5,621	20·4	4,656	16·9	2,293	8·3
ing { Edinburgh ...	1,671	14·7	1,860	16·3	771	6·8
Dundee ...	805	18·4	697	15·9	313	7·2
Other Districts ...	9,511	17·2	8,368	15·1	2,631	4·7
<i>2nd quarter—</i>						
Large Burghs ...	13,253	19·6	8,884	13·1	5,753	8·3
includ- { Glasgow ...	5,853	21·0	3,710	13·3	2,507	9·0
ing { Edinburgh ...	1,891	16·4	1,456	12·7	1,016	8·8
Dundee ...	860	19·5	562	12·7	345	7·8
Other Districts ...	10,001	17·9	7,316	13·1	3,342	6·0
<i>3rd quarter—</i>						
Large Burghs ...	12,078	17·7	7,312	10·7	7,644	11·2
includ- { Glasgow ...	5,251	18·6	2,940	10·4	3,200	11·4
ing { Edinburgh ...	1,773	15·2	1,267	10·9	1,447	12·4
Dundee ...	788	17·6	513	11·5	528	11·8
Other Districts ...	9,486	16·8	6,149	10·9	3,630	6·4
<i>4th quarter—</i>						
Large Burghs ...	12,061	17·6	9,476	13·9	6,299	9·2
includ- { Glasgow ...	5,383	19·1	4,223	15·0	2,745	9·7
ing { Edinburgh ...	1,703	14·6	1,549	13·3	1,057	9·1
Dundee ...	742	16·6	574	12·8	402	9·0
Other Districts ...	9,064	16·0	7,012	12·4	3,609	6·4

No. III.—NORTHERN IRELAND.

NORTHERN IRELAND.—*Number of Births, Deaths and Marriages for each Quarter of 1935 and their Proportion to the Population.*

	Births.		Deaths.		Marriages.	
	Number.	Annual rate per 1,000 of population.	Number.	Annual rate per 1,000 of population.	Number.	Annual rate per 1,000 of population.
1st quarter ...	6,110	19·0	5,498	17·1	1,573	4·9
2nd „ ...	6,511	20·2	4,754	14·8	3,292	7·1
3rd „ ...	6,274	19·5	3,845	11·9	2,620	8·1
4th „ ...	5,854	18·2	4,499	14·0	2,325	7·2
Total for year 1935	24,749	19·2	18,596	14·4	8,810	6·8

Population of Northern Ireland, calculated provisionally to mid-1935 (inclusive of military):—1,288,000.

	Births.		Deaths.		Marriages.	
	Number.	Annual rate per 1,000 persons.	Number.	Annual rate per 1,000 persons.	Number.	Annual rate per 1,000 persons.
1st quarter—						
Total rural districts	2,724	17·6	2,542	16·5		
Total co. boroughs and urban dists.	3,386	21·2	2,956	18·5		
Belfast C.B. ...	2,122	20·4	1,994	19·2		
Londonderry C.B.	304	26·9	174	15·4		
2nd quarter—						
Total rural districts	2,842	18·4	2,320	15·0		
Total co. boroughs and urban dists.	3,669	23·0	2,434	15·2		
Belfast C.B. ...	2,328	22·4	1,501	14·5		
Londonderry C.B.	316	28·0	197	17·4		
3rd quarter—						
Total rural districts	2,732	17·7	1,818	11·8		
Total co. boroughs and urban dists.	3,542	22·2	2,027	12·7		
Belfast C.B. ...	2,285	22·0	1,263	12·2		
Londonderry C.B.	291	25·8	166	14·7		
4th quarter—						
Total rural districts	2,565	16·6	2,158	14·0		
Total co. boroughs and urban dists.	3,289	20·6	2,341	14·7		
Belfast C.B. ...	2,113	20·4	1,480	14·3		
Londonderry C.B.	279	24·7	184	16·3		

Details not available.

No. IV.—IRISH FREE STATE.

Number of Births, Deaths and Marriages in the Irish Free State for each quarter of the year 1935 and their proportion to the population.

1935.	Births.		Deaths.		Marriages.	
	Number.	Annual rate per 1,000 of population.	Number.	Annual rate per 1,000 of population.	Number.	Annual rate per 1,000 of population.
1st quarter ...	14,417	19.0	11,381	15.0	3,805	5.0
2nd „ ...	14,913	19.7	10,933	14.4	3,063	4.0
3rd „ ...	14,941	19.7	8,791	11.6	4,084	5.4
4th „ ...	13,948	18.4	10,384	13.7	3,245	4.3
Total for year 1935	58,219	19.2	41,489	13.7	14,197	4.7

Population of the Free State estimated to mid-1935 :—3,033,000

1935.	Births.		Deaths.		Marriages.	
	Number.	Annual rate per 1,000 persons.	Number.	Annual rate per 1,000 persons.	Number.	Annual rate per 1,000 persons.
<i>1st quarter—</i>						
Total rural districts	8,712	16.3	7,556	14.2		
Total urban „	5,705	25.3	3,825	17.0		
Dublin City ...	3,004	28.0	1,933	18.0		
Cork Co. Borough	456	23.2	286	14.6		
<i>2nd quarter—</i>						
Total rural districts	9,183	17.2	7,426	13.9		
Total urban „	5,730	25.4	3,507	15.6		
Dublin City „ ...	2,955	27.6	1,628	15.2		
Cork Co. Borough	465	23.7	327	16.7		
<i>3rd quarter—</i>						
Total rural districts	9,042	17.0	6,027	11.3		
Total urban „	5,899	26.2	2,764	12.3		
Dublin City „ ...	2,923	27.3	1,336	12.5		
Cork Co. Borough	521	26.6	241	12.3		
<i>4th quarter—</i>						
Total rural districts	8,771	16.5	7,047	13.2		
Total urban „	5,177	23.0	3,337	14.8		
Dublin City „ ...	2,569	24.0	1,609	15.0		
Cork Co. Borough	425	21.7	304	15.5		

Note.—Dublin City rates based on 1935 population estimate; the others on census population, 1926.

No. V.—GREAT BRITAIN AND IRELAND.

SUMMARY of BIRTHS, DEATHS and MARRIAGES, in the Year 1935.

(Compiled from the Quarterly Returns of the respective Registrars-General.)

Countries.	[000's omitted.]		Live Births.	Per 1,000 of Popula- tion.	Deaths.	Per 1,000 of popula- tion.	Mar- riages.	Per 1,000 of popula- tion.
	Area in statute acres.	Popula- tion middle 1935, estimated						
		No.	No.	Ratio.	No.	Ratio.	No.	Ratio.
England and Wales ... }	37,340	40,645	599,167	14·7	477,371	11·7	348,312	8·1
Scotland ..	19,462	4,955	87,923	17·8	65,331	13·2	37,973	7·7
Northern Ire- land ... }	3,488	1,288	24,749	19·2	18,596	14·4	8,810	6·8
Great Britain and North- ern Ireland }	60,290	46,888	711,839	15·2	561,298	11·9	395,095	8·4
Irish Free State ... }	17,254	3,033	58,219	19·2	41,489	13·7	14,107	4·7

Exports:—Declared value of U.K. Produce and Manufactures, and of Imported Merchandise, exported from the United Kingdom in the years ended December 31 1933, 1934, 1935.

Countries to which consigned.	1933.		1934.		1935.	
	Exports.	Re-exports.	Exports.	Re-exports.	Exports.	Re-exports.
	£'000.	£'000.	£'000.	£'000.	£'000.	£'000.
Russia	3,341	957	3,640	3,905	3,505	6,206
Finland	2,846	256	3,612	387	4,152	464
Sweden	7,175	674	9,083	793	9,721	819
Norway	5,554	261	6,292	254	6,620	386
Denmark,* with Faroe Islands	11,797	477	13,357	731	13,765	776
Poland, including Dantzig	2,738	1,108	3,001	1,262	3,785	1,313
Germany	14,821	9,777	14,008	8,899	18,944	7,457
Netherlands *	12,371	1,976	12,090	1,991	11,665	2,301
Java	2,148	45	1,832	40	1,821	39
Belgium *	8,834	4,107	8,796	4,111	8,684	4,443
France *	18,152	7,623	16,751	6,719	16,708	6,809
Switzerland	3,946	634	4,648	790	4,076	928
Portugal *	3,926	120	3,629	157	4,174	229
Spain *	4,493	214	4,794	274	5,353	413
Italy *	9,054	882	9,314	1,223	6,796	1,350
Czechoslovakia... ..	860	151	1,247	240	1,432	307
Greece	1,946	107	2,682	240	2,925	282
Roumania	2,385	57	2,679	80	1,210	54
Turkey, European and Asiatic, incl. Smyrna and Armenia...	1,459	63	1,172	58	1,021	27
Egypt	6,260	184	6,528	226	7,665	205
China †	6,300	113	6,513	80	5,022	36
Japan ‡	4,425	152	3,810	165	4,007	131
United States	19,138	7,070	17,571	5,642	22,884	7,225
Cuba	596	8	919	10	878	16
Mexico	1,420	15	1,583	16	1,387	13
Peru	897	35	1,101	29	1,030	42
Chile	731	26	1,448	43	2,055	37
Brazil	6,165	153	5,742	140	4,765	139
Uruguay	1,752	25	1,694	25	1,523	42
Argentine Republic	13,073	214	14,655	249	15,263	344
Other Countries	25,789	1,152	26,221	1,188	28,771	1,470
Total—Foreign Countries	204,392	38,638	210,412	40,167	221,607	44,303
BRITISH POSSESSIONS.						
Irish Free State	19,034	4,635	19,525	5,280	20,180	4,924
British West Africa	6,362	498	5,754	385	9,294	500
Union of South Africa	23,402	617	30,219	627	33,596	655
British East Africa	2,192	68	2,445	55	2,925	71
British India, with Burma	33,402	691	36,675	540	37,815	623
Straits Settlements and Federated Malay States	5,346	118	6,993	140	7,414	155
Ceylon and Dependencies	2,131	71	2,837	71	3,200	80
Australia	21,341	736	26,243	715	29,388	700
New Zealand	9,547	258	11,438	260	13,360	273
Canada	17,444	1,112	19,726	1,388	21,387	1,175
Brit. W. Indies, with Bahamas	4,632	170	4,861	140	4,972	148
Other Possessions	18,684	1,469	18,857	1,476	20,783	1,659
Total—British Possessions	163,517	10,443	185,573	11,077	204,314	10,963
Total—Foreign Countries and British Possessions	367,909	49,081	395,986	51,243	425,921	55,265

* Excluding colonies.

† Excluding Hong Kong, Macao, and leased territories; including Weihaiwei and Manchuria.

‡ Including Formosa and leased territories; excluding Korea.

Imports.—*Declared value of merchandise imported into the United Kingdom in the years ended December 31, 1933, 1934, 1935.*

Countries from which consigned.	1933.	1934.	1935.
	£'000.	£'000.	£'000.
Russia	17,491	17,327	21,734
Finland	12,767	15,215	14,959
Sweden	15,938	17,926	17,013
Norway, including Spitzbergen	6,961	8,359	8,212
Denmark,* including Faroe Islands	35,428	32,885	32,037
Poland, including Dantzig	6,551	7,438	7,281
Germany	29,814	30,578	30,044
Netherlands *	18,603	20,947	23,104
Java	3,381	4,222	4,339
Belgium *	12,918	14,563	15,495
France *	19,085	19,236	21,637
Switzerland	5,224	5,487	5,395
Portugal *	2,724	3,179	3,129
Spain *	11,166	11,263	11,326
Italy *	9,217	8,422	7,919
Czechoslovakia	2,895	3,681	4,339
Greece, excluding Crete	2,055	2,287	2,069
Roumania	4,160	3,421	3,215
Turkey, European and Asiatic, including Smyrna and Armenia	1,150	926	1,002
Egypt	12,387	11,470	12,738
China †	5,095	6,142	6,271
Japan †	7,131	7,983	8,271
United States	75,814	81,956	87,502
Cuba	4,280	3,768	3,789
Mexico	2,514	3,106	3,323
Peru	4,706	4,879	3,827
Chile	3,756	5,237	5,183
Brazil	4,807	8,440	7,210
Uruguay	3,466	3,180	3,382
Argentine Republic... ..	41,687	47,030	43,995
Other Countries	42,708	49,576	52,330
<i>Total—Foreign Countries</i>	425,879	460,129	472,070
BRITISH POSSESSIONS.‡			
Irish Free State	17,791	17,200	18,747
British West Africa	5,750	6,091	8,231
Union of South Africa	14,519	11,891	13,692
British East Africa	4,162	3,048	3,499
British India, with Burma	37,352	42,102	41,129
Straits Settlements and Federated Malay States	4,626	12,380	10,891
Ceylon and Dependencies	9,081	11,324	10,039
Australia	48,551	49,929	54,307
New Zealand	37,171	40,440	38,127
Canada	46,216	50,390	55,995
British W. Indies, with Bahamas... ..	5,757	6,295	7,081
Other Possessions	18,161	20,195	23,129
<i>Total—British Possessions</i>	249,137	271,285	284,867
Total—Foreign Countries and British Possessions	675,016	731,414	756,936

* Excluding colonies.

† Excluding Hong Kong, Macao and leased territories; including Manchuria.

‡ Including Formosa and leased territories; excluding Korea.

§ Including Protectorates and Mandated Territories.

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THE EXPENDITURE AND REVENUE OF LOCAL AUTHORITIES.

By **SIR GWILYM GIBBON, C.B., C.B.E., D.Sc.**

[Read before the **ROYAL STATISTICAL SOCIETY**, March 17th, 1936, the
PRESIDENT, PROFESSOR M. GREENWOOD, F.R.S., in the Chair.]

I. Preliminary Observations.

THIS paper deals chiefly with the expenditure of Local Authorities in England and Wales during approximately the last fifty years, with the addition of some statistics of capital commitments and of rates and grants, all of them much discussed in recent years. In the early days the statistics of local public expenditure received a good deal of attention in the Proceedings of the Society. Mr. Purdy, for many years the head of the Statistical Department of the old Poor Law Board (afterwards merged in the Local Government Board), was Secretary of the Society. They have not received much notice in recent years, though they have become much more important and certainly not less interesting. They have been squeezed out by figures of trade and finance, which have been more prominent in the public eye and perhaps lend themselves more readily to romance, and romancing, though the latter is not wholly absent from local statistics. Yet local statistics merit, and need, far more attention. Local taxation and how best to provide the monies required for local services are problems vexing every modern country. Within my present compass, I must necessarily restrict myself to a broad summary. I have chosen to deal primarily with expenditure because that is the starting point for examining local finances and it provides abundance of provender.

In this field, as in most others, for a long survey difficulties arise because statistics have not been compiled on the same basis. In particular, in the statistics of local expenditure published by the Local Government Board, loan charges were not shown separately

for each service until 1913-14. The Ministry of Health, however, have published figures for a number of the earlier years in which loan charges, and other expenditure, are allocated to services classified in a number of large groups; these figures are set out in Tables I and II of the appendix, the first giving the total and the second the per head expenditure, and are used in the present paper. The method adopted for the allocation of loan charges, where definite figures were not available, was to distribute the charges in proportion to outstanding debt, a simple and reasonably sound method.

Account has to be taken of many other facts in considering statistics of local finance. The functions of local authorities have, of course, greatly increased. Many private concerns have been taken over by local authorities, the most notable being the formation of the Port of London Authority and of the Metropolitan Water Board, both of whose expenditures appear in the local statistics, those for the former first appearing in 1909-10 and those for the latter in 1913-14; other companies have been acquired by local authorities. There has not been much contrary movement, but the formation of the London Passenger Transport Board has provided a big recent exception.

One of the fundamental difficulties of statistics is to be sure that each unit is equal to the other, an ideal rarely attained. This difficulty is as serious in local statistics as in most fields. As I do not propose to deal with individual authorities, I am not concerned, except when dealing with different classes of authorities, with the large disturbances caused by changes of areas (large disturbances of feelings also when proposals are discussed!), but account has to be taken of the much larger proportion of the population now living in urban areas, where services and expenditure are larger than in rural, and, in particular, the bigger proportion in large towns, where local costs are highest. The townsman needs, and demands, more than the countryman. Comparing 1881 and 1931, the percentages of the population of England and Wales living in urban areas were 68 and 80; the percentages living in towns of over 50,000 persons were 35 and 51. The estimated average rates collected per head of population in 1934-5 for London, County Boroughs, other Boroughs and Urban Districts, and Rural Districts, were respectively £6 10s., £4 3s., £3 10s. and £2 4s., the average for England and Wales being £3 16s.

The total number of "local authorities" with financial transactions, including joint authorities, was in 1884-5 some 28,000; in 1894-5, over 33,000; in 1913-14, 25,600; and in 1932-3, 11,500. The reduction in number of authorities indicates the tidying of local government. Many of these authorities had small expenditure.

Broadly speaking, the larger the authority the bigger its resources, the more its services and the larger its expenditure.

Account has to be taken of changes in the age-distribution of the population. The following table illustrates the position.

PERCENTAGE OF POPULATION IN VARIOUS AGE-GROUPS.

Year.	0-5.	5-15.	15-20.	20-60.	60-70.	70 and over.	80 and over.	All ages.	
1881	13.6	22.9	36.5	9.8	46.4	4.7	2.6	7.3	100
1931	7.5	16.3	23.8	8.6	56.0	7.3	4.3	11.6	100

The groups which most affect local expenditure are the young and the old. The former constitute a smaller proportion, but against this has to be set the fact that the services of local authorities for the young have greatly increased in recent years. The proportion in the older ages has risen greatly. It is true that very much more is being done by the State for the aged, but the services of local authorities have also increased.

Changes of this nature, however, have small effect, within the period considered, compared with the enormous increase in functions, and also because public service is now rendered, as in education, to additional sections of the community. Standards have risen; the most notable present instance is in housing, but it is true also of other services. We are in an era when the services of public authorities grow larger and larger, in other countries as well as our own.

The significance of the figures which will be given can be rightly gauged, of course, only if account is taken of changes in the value of money, especially in the years after the war, and of changes in national wealth.

Another important matter is the change, almost a revolution, in the relations between central and local government. In the first place, the former has taken on functions bearing on local services and expenditure, particularly the grant of old age pensions in 1908 to persons in need over 70 years of age, the unemployment and the health insurance schemes of 1912, pensions for the blind in 1920, the widows', orphans' and old age contributory pensions of 1925, and now the maintenance of the able-bodied unemployed, which continues, and adds to, the previous provision from State funds for the maintenance of insured persons who had fallen out of benefit. Needs are being increasingly met as public service, not as relief, and the public service is increasingly being provided by the State, or with liberal State aid, because needs are greater than can be met from local resources and because they are increasingly of national

incidence. One conspicuous fact is nevertheless the continued large expenditure on poor relief.

In the second place, there has been great increase of central aid for local services. The sources of local taxation have not shown any substantial change, with one big exception—the complete derating of agricultural land and the large derating (three-fourths) of industrial and freight-transport undertakings by the Local Government Act of 1929, which had been preceded by the partial derating of agricultural land, to one half in 1896 with a further quarter in 1923. Within the period, however, measures have been taken for the more adequate assessment of properties, especially after the passing of the Valuation Act of 1925, and rating is now generally on higher values. The increase of central aid has been partly to make good the reduction of local resources by Acts of Parliament, but also to provide larger assistance to local services and to produce more equitable distribution of burdens. Local taxation is not elastic enough for modern needs nor does it draw from a sufficiently wide field, and it is unlikely that these handicaps can ever be overcome.

I have thought it well to preface the statistics of expenditure with some cautionary remarks, because often sufficient account is not taken of these conditions in interpreting the figures of local expenditure.

The statistics published by the Ministry of Health (from which most of the information is drawn), as those of the Local Government Board, are based on annual returns from the local authorities. The errors in these returns, the most likely being in allocation of expenditure to the several services, are probably not such as materially to affect the figures in this paper. I am much indebted to the Statistical Department of the Ministry for assistance.

II. Gross Expenditure.

Total Expenditure.

Gross expenditure provides the best index of the activities of local authorities, subject to one qualification. Local services may be divided broadly into operative, those where the authority carries on undertakings, such as education, public cleansing or a trading service, and regulatory, those where the authority regulates the undertakings of others, such as the making and the administration of bye-laws and of planning schemes. The relative importance of these two classes is not to be measured by money spent.

I have given in Tables I and II of the appendix the expenditures

for the year 1884-5 and for each subsequent tenth year, except that the last figures are for 1932-3, those being the latest available when this paper was prepared. The figures for 1933-4 will shortly be published. Some delay unavoidably occurs in publication because there are always some laggards in furnishing returns, but the issue of the statistics has been accelerated in recent years. The statistics are also now published in much handier form, and the returns required of local authorities have been much improved. In the old days local statistics were published in seven volumes, a mine of information for the student, provided that he abounds in patience, but not handy for general use. In Table IV of the appendix, I have given the expenditure for a few years for the several services in more detail and with loan charges allocated, as now published by the Ministry of Health. It has not been possible to do this in Tables I and II because particulars were not furnished in such detail in earlier years; in addition, as already stated, until recent years loan charges, an important item of expense, were not stated for each service. I have given, however, in Table III, the expenditure from 1884-5 onwards divided in more detail for services, but with loan charges shown as a separate item.

The gross expenditure on revenue account of all local authorities in the several years is as follows :—

Gross Expenditure.	1881-5.	1894-5.	1904-5.	1914-15.	1924-5.	1932-3.
Total, £m. ...	44.1	59.7	107.7	153.3	354.9	430.3
Average per head of population ...	<i>s. d.</i> 32 10	<i>s. d.</i> 39 6	<i>s. d.</i> 64 1	<i>s. d.</i> 83 1	<i>s. d.</i> 183 3	<i>s. d.</i> 214 1

As previously stated, the expenditure includes that of some bodies not ordinarily regarded as local authorities, the principal being that of the Port of London Authority (from 1909-10), of the Metropolitan Water Board (from 1913-14) and of the Mersey Docks and Harbour Board.

The expenditure per head of 1932-3 is $6\frac{1}{2}$ times that of 1884-5 and more than $2\frac{1}{2}$ times that of 1914-15. It is desirable to reduce the figures for the several years to a common basis of value. I do not know of any suitable index and have not had time to try my hand at one. It would be an interesting exercise, and I hope that someone who labours in this field of snares will attempt it. There are many factors to be considered. Salaries and wages constitute not far short of one-half of the expenditure of local authorities, and general indices are not likely to be a reliable guide to changes in the local services. Even for purchase of goods and for contracts for works, while general indices may provide

some indication they would probably not of themselves be sufficient. Loan charges are a big item in the annual expense, roughly about one-quarter of the total. They may run, according to the purposes, for as long as 80 years for a few (even 100 years for very few) to 5 years. Account has to be taken not only of interest on borrowings and re-borrowings, but also for the cost of works (works carried out in 1920, for instance, might have cost twice or more as much as similar works in 1914). A reliable index therefore needs much careful thought and labour, but provides all the more interesting an exercise. I have consulted some experienced persons to check my own opinion and, as might be expected, even allowing for local differences the estimates vary a good deal, from about 30 per cent. to over 60 per cent. Fifty per cent. may be taken, though not as more than an informed guess, subject to a large plus or minus. Adopting 50 per cent., the 83s. per head of 1914-15 becomes 124s. 6d., as compared with 214s. for 1932-3, an increase of over 70 per cent. There was probably no large change of money values affecting local expenditure in the earlier years, though the local authorities doubtless benefited from the general fall of prices to 1896, and paid more with the subsequent rise.

Growth in the Several Years.

The decades with large increases in expenditure are those of 1894-5 to 1904-5 and 1914-15 to 1924-5.

The latter, where the growth per head was about one and a quarter times, was to be expected, and is due largely to monetary inflation, but by no means wholly.

What may surprise some with recollection of the politics of the last fifty years is the outstanding increase in the decade 1894-5 to 1904-5, because the Liberal Government of 1904 came into office in fervour of reform; but this fervour was mainly political in the early years. Although the Old Age Pensions Act was passed in 1908, this and the later big social reforms concerned chiefly central, not local, government.

The expenditure per head in 1904-5 exceeded that in 1894-5 by over 60 per cent. The largest increase was in education, following on the Education Act of 1902, and in particular the new charge on local funds for voluntary schools.

III. Expenditure on the Several Services.

Education.

What stands out prominently is the tremendous increase in educational expenditure during the fifty years. In 1884-5 it

averaged 2s. 11d. per head; in 1904-5, 13s. 2d.; in 1932-3 it had reached 41s. 1d., over 14 times as much as in 1884-5.

In 1884-5 it came third in order (excluding the principal trading services), being exceeded by poor relief and by highways, the former with a figure of 5s. 7d. and the latter of 4s. 11d. It had reached first place by 1904-5, and retained it in 1932-3, with the figure of 41s. 1d. as against 23s. 3d. and 22s. 11d. for its nearest rivals, highways and public health.

In 1884-5 the expenditure on education was about one-tenth of the total on services other than the principal trading; in 1932-3 it was over a fourth.

This vast growth in expenditure raises the question whether adequate value is being obtained in return. I do not know, and I do not know that anyone knows, though faith abounds. The general demand is for an increase of facilities with increase of expenditure. Without delaying measures of expansion now on foot, the time seems ripe for a thorough impartial investigation into the question, extremely difficult though it would be, an investigation in which educational experts should not be predominant in final judgment.

Highways.

After education, the next highest expenditure in 1932-3 was on highways, including bridges and the cleansing of roads, and amounted to 23s. 3d. per head, being a little higher than that on public health.

It may surprise some that the increase in expenditure on highways has not been even larger. It shows an increase of between 4 and 5 times per head, as compared with an increase of 14 times on education. Highways, and the work on them, can be seen by all, the Press has been very full of them in recent years and much has been said on highway work for relieving unemployment, while expenditure on education has not been so manifest, except to those who look at the figures. Further, a large part of the spending on highways is in capital, with loan charges spread over a term of years, and maintenance is a much smaller proportion of the revenue expenditure on this service than on education. In 1932-3, in the former service, loan charges were nearly 21 per cent. of the revenue expenditure; in the latter, only just over 7 per cent.

But the 23s. 3d. per head does not show the full expenditure. In education, police and other services for which specific grants are given, the grants are usually provided to help in meeting the charges falling on the local authorities and are included in their ordinary expenditure. This is also so for the grants towards road maintenance. The grants towards capital expenditure on the construction and improvement of roads are made as lump-sum payments, which

reduce the amount of capital that the local authorities have to raise, and are therefore not included in their revenue expenditure either directly or as loan charges.

This makes a substantial difference. During the ten years ending 1932-3, the returns made by local authorities showed the receipt of £45.2m. towards the capital cost of the construction and improvement of roads. Taking the average interest at 4 per cent., which is on the low side considering the rates of interest of the earlier years, and allowing a loan period of 30 years, which is on the high side because the period would have been shorter for some of the work, though longer for the acquisition of land, a sum of £2.6m., equivalent to $5\frac{1}{2}$ per cent. of the total expenditure on roads in the year 1932-3, would have been required to meet the annual charges on this sum.

No central grants, for capital or maintenance, were made expressly for roads in the early years, except that a small grant, of approximately £205,000 in 1884-5, was made towards the maintenance of disturnpiked and main roads until discontinued as part of new financial arrangements under the Local Government Act of 1888. Therefore, the expenditures of 1884-5 and of 1932-3 do not provide a wholly correct comparison of the respective burden on the public. It must be noted, however, that the road fund from which the grants are made is provided out of special taxation on road users—not without complaints of inequity in general and as between different classes of users!—and is therefore not a burden on the general taxpayer except so far as taxes of that kind might otherwise have been used in larger measure for general purposes.

The highway expenditure of local authorities was the second highest in 1884-5, 1904-5 and 1932-3. But it is relatively less, being 20 per cent. of all expenditure, excluding that on the principal trading services, in 1884-5 and 14 per cent. in 1932-3.

Public Health.

This heading includes a variety of services. The best concise indication is afforded by the more detailed statistics for 1932-3, but it has to be borne in mind that some of these services were not provided in the earlier years, particularly those relating to maternity and child welfare, tuberculosis, venereal diseases, general hospitals and the welfare of the blind, while other services have been greatly extended. The services are set out in order of expenditure, and, in addition to the gross expenditure (E), figures are given for fees and other recoupments (R), Government grants (G), and the balance to be met from rates, unallocated grants and other receipts not for specific services (B):—

(£m.)

Services.	E.	R.	G.	B.
Hospitals, Sanatoria, Dispensaries, etc. :—				
For Tuberculosis	3.6	0.1	0.0	3.5
„ Venereal Diseases	0.4	0.0	—	0.4
„ Other Diseases (Diphtheria, etc.)	3.4	0.2	0.0	3.2
„ General Hospitals	4.1	0.4	0.0	3.7
	— 11.5	— 0.7	— 0.0	— 10.8
Sewers and Sewage Disposal... ..	11.1	0.6	1.2	9.3
Collection and Disposal of House Refuse	7.1	0.5	0.0	6.6
Parks, and other open spaces	5.3	1.1	0.2	4.0
Maternity and Child Welfare	3.1	0.5	0.0	2.6
Baths, Washhouses	2.4	1.1	0.0	1.3
Salaries of Medical Officers of Health, Sanitary Inspectors, and Health Visitors so far as not allocated to specific services	1.7	0.0	—	1.7
Welfare of the Blind	1.0	0.1	—	0.9
Public Conveniences	0.9	0.3	0.0	0.6
Other Health Services (including vaccination, notification of disease, general disinfection, port sanitary service, etc.)	1.9	0.2	0.1	1.6
Totals	46.0	5.1	1.5	39.4

It will be seen that the provision of hospitals, sanatoria and dispensaries, of sewers and sewage disposal, the collection and disposal of house refuse, the provision of parks and other open spaces, maternity and child welfare and the provision of baths and washhouses account for most of the expenditure. A substantial return is not received in specific payment for services except from baths and washhouses and, in less measure, from parks and other open spaces. Specific government grants provide little revenue, and most of this is from grants towards the capital cost of works carried out to relieve unemployment.

Public Health is not separately distinguished for the years 1884–5 or 1894–5 in the special table published by the Ministry of Health, though the expenditure on some items was already heavy. In 1904–5, the expenditure per head of population on this service was 6s.; in 1932–3, 22s. 11d. It comes next after education and highways, and is nearly as much as the latter.

As stated, a large part of the expenditure under public health is for sewerage and sewage disposal and the collection and disposal of refuse, still, with water supply, the most fundamental of public health labours. These services have been greatly extended and improved in recent years. At the same time, closer attention has

been paid to economy, and a system of costing has been applied. In the collection and disposal of refuse (and the cleansing of roads and streets) costing has now been in force for several years, with excellent results. Though collection and disposal has been greatly improved and the number of houses has increased since the war by over two million and systematic collection has been extended to new areas, the cost of the service has not increased in recent years, a noteworthy achievement.

Maternity and child welfare, the treatment and care of the tuberculous, including the provision of many sanatoria, the treatment of venereal diseases and the welfare of the blind have been instituted since the beginning of the present century. The provision of hospitals for the isolation and treatment of persons suffering from infectious diseases dates from early days; in recent years, following on the Local Government Act of 1929, many hospitals for general treatment have been transferred from the poor law to public health, and correspondingly the expenditure. This expenditure is likely greatly to grow. The money spent on "general hospitals" is shown first in the official statistics for the year 1930-31, when the total (excluding capital expenditure) was £1.3m.; in 1932-3, with more hospitals transferred and three times as many patients on the average, it reached £4.1. Another worthy service on which expenditure has much expanded in recent years is that of open spaces of various kinds, and the need is still far from fulfilled. In 1919-20 the expenditure on this head, other than capital, was £2.5m.; in 1932-3, £5.3m.

It is simpler in public health than in several other services to obtain objective tests of results, and the figures of mortality of different groups and from diseases tell of an excellent record, though these are not of themselves sufficient, and other causes besides the work of local authorities have contributed their share. There are few subjects which more merit investigation than better objective tests of the return obtained from the labours and expenditure of public bodies.

Housing.

The increase of expenditure on housing provides, with that on education, the most striking feature of the half-century. In 1884-5, it was only 3*d.* per head; in 1932-3 it had risen to 19*s.* 5*d.* (Expenditure in respect of loans for the acquisition of small dwellings by occupiers is excluded from this section.) From being less than 1 per cent. of the total expenditure, excluding the principal trading services, it had grown to over 12 per cent.

The increase is post-war. Housing conditions had previously

aroused much attention. The national movement started in the eighteen-sixties. But it was directed mainly to unfit houses, and expenditure was not large. The building of houses had been left almost wholly to unaided private enterprise. The land taxation of one of the budgets shortly before the war was heartily damned as having stopped this private enterprise for working-class houses, but, while no doubt it had some effect, chiefly psychological, the private building of houses for the more lowly-paid workers had for some years generally declined, for reasons which are often not fully realized, and had already brought pressure for more building by local authorities. The war gravely accentuated the shortage; after the war public opinion demanded measures for meeting it and that by leaps and bounds, and the result was first the multitude of houses built by local authorities, in the beginning at much inflated costs, and later by subsidized private enterprise.

The great housing activities of the post-war years have laid a heavy burden on tax- and rate-payer, the former in particular. In 1932-3 the total expenditure, excluding capital, was £39·0m.; rents and other receipts produced £23·3m., leaving a balance of £15·7m. Towards this, the State contributed £12·7m., the local authorities £3·0m.; but the State contributes part also of the £3·0m., through the block grants which are in aid of rate charges in general.

The large amount borne by the State is to be attributed to the policy of the first Housing Act after the war, coupled with the pressure on local authorities rapidly to produce new houses which, with post-war conditions of production, led to the exceedingly high costs. Under that Act the State bears the liability for all the deficiency over the produce of a penny rate in the several districts—though local authorities claim that in practice some further liability falls on them.

The figures are instructive. In the published returns of the Ministry of Health, statistics are given for three groups of schemes—A, assisted schemes under the Housing Act of 1919; B, other State-aided schemes; C, other schemes. The expenditure and income for 1932-3 were as follows :—

£m.

	Gross Expenditure.	Rents, etc.	Government Grants.	Balance of Expenditure.
A	13·55	5·82	6·60	1·13
B	23·63	15·91	6·13	1·59
C	1·82	1·59	0·00	0·22

Reduced to percentages this table becomes :—

	Gross Expenditure.	Rents, etc.	Government Grants	Balance of Expenditure.
A	100	43	48·7	8·3
B	100	67·3	26·0	6·7
C	100	87·6	0·1	12·3

On the houses under the Act of 1919, rents etc. bear only a little more than 40 per cent. of the charges, while nearly 50 per cent. falls on the State. On the other assisted houses, rents etc. provide over two-thirds, but the proportion in the houses owned by the local authorities is larger because provision for meeting the annual charges on subsidies for houses privately owned is included in the "balance of expenditure." On the other hand, "rents etc." includes large sums for rates on houses owned by local authorities, where the rent is inclusive, the portion for rates being later credited to the rate accounts; the sums included in the foregoing figures for rates are, approximately—for 1919 houses, £880,000; for other assisted houses, £3,630,000; for other houses, £300,000.

It may be mentioned that in future these charges will not be set out separately for the several classes of houses because, under the Housing Act of 1935, the grants for all of them will be consolidated, good for the accountant but unfortunate for the statistician. It should also be said in caution that the above figures are, of course, averages, and do not apply to any particular houses.

The policy of 1919 was a costly experiment, and it is easy now to criticize the measures adopted, but account has to be taken of the then compelling and almost universal demands, the state of public opinion and the general conditions prevailing after the war.

It is interesting to compare the foregoing figures with those for education on which in the same year £82·6m. was spent and £4·2m. was received in fees etc., leaving £78·4m. to be found, of which £38·8m. was provided by the State and £39·6m. by local authorities, from rates, block grant and other unallocated revenues.

Poor Relief.

One of the most striking records is that of the expenditure on poor relief. The increase is not comparatively large, from 5s. 7d. per head in 1884–5 to 16s. 3d. in 1932–3 an increase of less than three times, against that of fourteen times for education. In the former year, the expenditure was the heaviest on any service, and was one-fifth of the total expenditure on services other than trading, as compared with one-tenth for the year 1932–3.

What makes the present expenditure so provocative of questions is the large public sums now spent on other forms of personal

assistance. As late as the first decade of the present century, apart from private charity the poor law was almost the only resort of the person in need. Since that time, there have been provided State old age pensions, State-aided insurance against unemployment, sickness and invalidity, State pensions for the blind and State-aided contributory pensions for the aged, for widows and for orphans; and, in addition, maintenance from State funds for able-bodied unemployed who have fallen out of insurance. Further, there have been provided by local authorities, with State assistance, maternity and child welfare, school medical service, with school meals where certified to be necessary, care for the tuberculous, for the blind, and for the mentally deficient, and, as already indicated, the transfer of a number of institutions formerly under the poor law to other local public services, in particular hospitals to public health. In the year 1932, the State alone spent over £124m. on pensions, insurance and the maintenance of the unemployed (with a further £40m. under the War Pensions and the Ministry of Pensions Acts). The net expenditure on the poor law not only did not diminish during this time, but largely increased, from £11·0m. in 1904-5 and £11·8m. in 1908-9 to £30·4 in 1932-3. All of which gives much food for thought, even allowing for reduced value of money and the intense and prolonged post-war depression. But adequate examination of the striking facts would need a separate paper, possibly several. There is no question that relief is being more readily sought and more readily given, that standards of relief have risen, that ties of family and neighbourhood have become looser, and that in some places, not numerous, there is corroding laxity; but these do not explain enough. Anathemas and the easy assumption that the development is due to depravity of standards lead nowhere; the position is here to stay and even to develop still further, it is embedded deep in social conditions and trends, and the task is to understand and to obtain the best results.

Police and Lunacy.

It is not suggested that there is any connection between these two! They are put together because only brief reference will be made to them.

The expenditure on police rose from 2s. 7d. per head of population in 1884-5 to 10s. 8d. in 1932-3, an increase of more than four times, an increase to be attributed to higher standards of service, more extensive duties, typical of the general development of government from regulation to service, and much higher rates of pay in the post-war period.

Care of the lunatic is one of the old public services and care of

the mentally deficient has been added in recent years. In the returns their cost is given separately, not under public health. In the past a large part of the care has fallen to the poor law, which still bears not a little.

The expenditure classed under lunacy and mental deficiency rose from 1s. 3d. in 1884-5 to 5s. 6d. in 1932-3 per head of population. The larger number of persons living in towns has added to the numbers in institutions and the standards of accommodation and services have risen, while more care is being given to the mentally defective. The growing proportion of elderly persons in the population is an important factor, with consequences for this and other public services which need to be much more considered.

Trading Services.

The expenditure on the trading services of local authorities has much increased, but not out of proportion to the growth of other expenditure. In 1932-3, the total expenditure in this sphere came to £115.4m., which compared with £318m. for other services, the latter including, however, some of a distinctly trading character, such as housing. (The foregoing and succeeding figures are corrected for surpluses and deficiencies, which accounts for a slight difference from other published figures.)

The bulk of the total expenditure is for electricity (£34.2m.); trams and buses (£26.2m.); water (£19.6m.); gas (£16.0m.); and harbours, docks, piers and canals (£12.2m.). The rest is, in order of expenditure, for markets, cemeteries, corporation estates, ferries and various miscellaneous services, the latter including some exceptional municipal activities such as a municipal bank at Birmingham, a telephone system at Hull, race-courses at Doncaster and Lincoln, the wool-conditioning house at Bradford and the provision of cold stores at Wolverhampton.

Loan charges constitute a large proportion of the total expenses in several of the trading services. The following is the average percentage of the loan charges to other working expenses in the principal—water supply, 100 per cent. (that is, loan charges were equal to other expenses); electricity, 65 per cent.; harbours, etc., 62 per cent.; gas, 23 per cent.; tramways, etc., 20 per cent. The figures have to be read subject to this qualification, that in some instances plant is still used on which the capital has been paid off; this is specially so in water supplies, some reservoirs and other plant, for example, over a hundred years old being still in service; this advantage has to be offset in some measure by higher maintenance charges, but probably not to a large extent.

Some trading undertakings date from a very early period of

local government. The original municipal corporations were, indeed, largely of the nature of a commercial venture, for taxes and trading concessions and for other matters. Markets were commonly in their hands, and were a basic part of privileges. The production of gas was "municipalized" in Manchester as early as 1817, long before the town received its charter, and quite illegally and not made legal until many years later. But trading undertakings on a large scale were not run by local authorities until the last two decades of the nineteenth century, and even then tramways owned by local authorities were run in many places by companies.

In the 'eighties and 'nineties some ardent individualists had nightmares of gigantic growth in municipal trading, with disastrous results to private enterprise and for initiative and progress. It is interesting to test how far these fears have been realized. The gross expenditure per head of the population on revenue account on the principal trading undertakings increased from 6s. 5d. in 1884-5 to 53s. 10d. in 1932-3, under 8½ times. The corresponding increase on the non-trading services has been from 26s. 5d. to 160s. 3d., an increase of just over 6 times. These figures somewhat discount the fears, though it has to be recognized that there is a strong demand in some quarters for a large extension of municipal trading, but if the desire for more public ownership should grow the municipality now has a strong competitor in the public corporation, such as the London Passenger Transport Board.

The increase in the expenditure on electricity has, of course, been large. It does not figure in the accounts for 1884-5; in 1894-5 the expenditure (excluding loan charges) per head was under 2d.; in 1932-3 it had reached 10s. 8d. But the expenditure on tramways, 'buses and light railways shows a like large increase; in 1884-5 it was negligible; by 1894-5 it was only a little over a penny per head; in 1932-3 it was 10s. 10d. The expenditure on water increased eight times, due partly to the taking over of the undertakings of companies, particularly those of the metropolis. The taking over of private enterprises is also an item in the expenditure on harbours, docks, etc., which increased from 1884-5 to 1932-3 to nearly 5 times, but the expenditure for the last year (3s. 10d. per head) was much less than that for 1924-5 (5s. 1d.).

The distinction between trading and non-trading services is in some measure artificial. Provision for the dead, cemeteries, is accounted a trading service; provision for the living, housing, has hitherto been regarded a non-trading service. There is no clear division. Some services which in this country are supported wholly out of rates are elsewhere subject to specific charges; it is interesting that in the United States charges have been increasingly made for

the use of sewers as one means of meeting local financial stringency in recent years. The following are non-trading services where for the year 1932-3 the specific receipts other than from rates or grants constituted 20 per cent. or more of the expenditure.

100 per cent.—Private Street Works; loans for the acquisition of small dwellings.

50-60 per cent.—Housing (59); allotments and small holdings (59).

40-50 per cent.—Baths (46); administration of justice (40).

30-40 per cent.—Public Conveniences (36).

20-30 per cent.—Mental hospitals and treatment (21); various services connected with agriculture and fisheries other than allotments, small holdings, and land drainage (23); parks and recreation grounds (22).

Other services where specific receipts were 10 per cent. or more were—miscellaneous health services, higher education, maternity and child welfare, port sanitary service, land drainage, fire brigades, and general hospitals. General overhead expenses are probably included in the foregoing figures in varying degree, but this would not make much difference in the percentages.

Taking the whole of the expenditure for 1932-3 on general (that is, "non-trading") services, approximately 16 per cent. was met out of specific income other than rates or grants, £53m. out of £318m.

Loan Charges.

Loan charges form a large item of expense on revenue account. I propose to discuss debt later, and will limit present comments to a comparison of charges with other expenses. Loan charges for all purposes, including trading, rose from £9.9m. in 1884-5 to £23.7m. in 1904-5 and to £106.7m. in 1932-3, but the proportion of loan charges to total revenue expenditure remained approximately the same, between 22 per cent. and 25 per cent. There was no substantial difference in proportion in any of the years with which I am dealing, except in 1924-5, when the percentage fell to 18, doubtless because of the large rise in prices and in wages, whereas the advantage of low rates of interest on past loans still continued. The steadiness of the proportions arises because day to day expenses on new and expanding old services increased, not by any means because of any slowing of new capital expenditure. The old Local Government Board were at times accused of taking too much account in determining loan periods of the possibility of heavy capital expenditure in the future; events have justified their caution.

Summary of Increases.

The following table summarizes the increase in the expenditure per head on the several services in 1932-3 compared with 1884-5 and 1904-5.

Service.	Expenditure per head in 1932-3; No. of times that of	
	1884-5.	1904-5.
Housing	78	57
Education	14	3
Principal trading services	8½	4
Highways	4½	2½
Police	4	3
Lunacy	3½	2½
Poor relief	3	2½
Public health	—	3½
Miscellaneous	2½	2
Total	6½	3½

It will be seen that, except for housing, there are no striking differences in the measure of increase in the 1904-5 to 1932-3 period. In 1884-5 to 1932-3, in addition to the great increase in housing, the rise in expenditure in education is outstanding, followed, at long distance, by the rise in that of the principal trading services, which is 1½ times that of the next (highways). The expenditure on public health was not separately stated in 1884-5, but there has been a large rise.

IV. Expenditure of Different Classes of Authorities.

The following table sets out the expenditure of the several classes of authorities for each tenth year from 1884-5 to 1924-5 and for two later years, to the nearest £0.1m.

£m.

Year.	Poor Relief.	County Councils (excluding L.C.C.).	County Borough Councils.	Other Borough Councils.	All Boroughs.	Other Urban Councils.
1884-5	9.6	2.5	—	—	13.3	3.4
1894-5	11.2	5.0	14.4	4.4	18.8	4.1
1904-5	15.3	13.5	34.3	9.4	43.7	9.4
1914-5	16.8	21.2	50.5	11.0	61.5	11.8
1924-5	38.4	57.6	122.3	26.0	148.3	28.1
1928-9	41.3	62.7	142.0	32.4	174.4	33.8
1932-3	(38.9)	92.3	172.4	39.5	211.9	34.7

Year.	Rural District Councils.	Metropolitan Area.	School Boards.	Harbour Authorities.	Others.	Total.
1884-5	2.4	5.5	3.7	2.4	1.2	44.1
1894-5	2.2	7.2	6.8	2.7	1.7	59.7
1904-5	3.6	15.4	0.4	3.6	2.7	107.7
1914-5	4.6	23.1	—	8.2	6.0	153.3
1924-5	14.0	45.3	—	12.2	11.1	354.0
1928-9	18.8	52.2	—	12.4	10.3	405.0
1932-3	19.4	58.8	—	11.2	11.0	430.3

Some explanations are necessary for the understanding of this table. Poor Relief was administered by special authorities until 1930-31, when it was transferred to County Councils and County Borough Councils, and the expenditure for subsequent years is included under County Councils and County Borough Councils and, for London, under "Metropolitan Area." The figure of £38.9m. entered for 1932-3 is the total expenditure on poor relief so included.

For the years 1884-5 and 1894-5 the figures under poor relief include also the expenditure of Overseers of the Poor. For later years it is included under "Others." The duties of Overseers were transferred by the Rating and Valuation Act of 1925 to the Rating Authorities (who are also Public Health Authorities).

In 1884-5 the authorities under "Other Urban Councils" were Urban Sanitary Authorities (other than Town Councils) and under "Rural District Councils," Rural Sanitary Authorities and Highway Authorities in rural districts. In 1894-5 they were respectively Urban Sanitary Authorities and Urban District Councils (other than Town Councils) and Rural Sanitary Authorities, Rural District Councils and Highway Authorities in rural districts. In 1904-5 and later years they were Urban District Councils (other than Town Councils) and Rural District Councils.

The figures under "Metropolitan Area" include for 1884-5 the expenditure of the Metropolitan Board of Works, the Metropolitan Vestries and District Boards, the Corporation of the City of London, the Commissioners of Sewers for the City and the Metropolitan Police. The area of the Metropolitan Police extends much beyond the administrative county of London, including now a number of County Boroughs, Other Boroughs and Urban and Rural Districts, and, therefore, some of the expenditure under this head should strictly be attributed to the authorities for those areas. By 1894 the London County Council had taken the place of the Metropolitan Board of Works, and by 1904-5 the Metropolitan Vestries and District Boards had been replaced by the Metropolitan Borough Councils and the Commissioners of Sewers for the City had been superseded.

In addition to new powers and duties and great extension of old, important transfers of functions have taken place, in particular—(1) the transfer by the Education Act of 1902 of elementary education from the School Boards to County Councils and County Borough Councils, except that, in non-County Boroughs with a population of 10,000 or more persons in 1901 and in Urban Districts with a population of 20,000 or more at that date, the Councils for those areas became the elementary education authorities, with power to relinquish their duties to the County Council; a few School Boards survived until 1904–5; the County Councils and County Borough Councils became the general authorities also for higher education: and (2) the transfer by the Local Government Act of 1929 of the administration of the Poor Law to County Councils and County Borough Councils and of the charge for the principal classes of public roads in urban areas and of all public roads in rural areas to the County Councils (main roads were already a County charge).

Many new County Boroughs, other Boroughs and Urban Districts have been constituted and many extensions of their areas made, the changes in County Boroughs effecting corresponding contrary changes in the counties. We are, therefore, not comparing the same areas (or populations) in successive years, but only classes of authorities, with many changes within the classes.

So much for the explanations, necessarily rather lengthy. Now for the figures. Comment has already been made on the expenditure on poor relief.

From the infants of the early days the County Councils have grown to great stature and girth. Their expenditure (excluding London) shows large increase, from a modest sum of under £5m. in 1894–5 to over £92m. in 1932–3 (£97m. in 1930–1). More work has been added to them than to any other class of authorities, a development not unlikely to continue under modern conditions. The rate of increase was exceptionally large between 1894–5 and 1904–5, due primarily to new duties in education. Another big jump occurred between 1924–5 and 1932–3, chiefly because of the new responsibilities for poor relief and roads.

The expenditure of County Borough Councils has also much increased, though proportionately less than that of County Councils, from just under £14½m. in 1894–5 to over £172m. in 1932–3. But, as already stated, County Boroughs have increased in number and area in the interval and Counties have diminished in area. As with County Councils, the increased expenditure between 1894–5 and 1914–15 is to be attributed largely to new educational duties, and that between 1924–5 and 1932–3 to new duties of poor relief.

The growth in the expenditure of other Borough Councils and

of Urban District Councils is not nearly so imposing, the trend being to more use of County Councils.

The Rural District Council is from its very position the Cinderella of Local Government—occupying, nevertheless, an important place. It stands to lose from urban development by the growth and extension of urban authorities and from the transfer of duties to County Councils. The drop in the expenditure of Rural Councils between 1928-9 and 1932-3 is to be attributed to the transfer to County Councils of the charges for roads previously borne by the former. The work of the Rural Councils as a whole has not been correspondingly reduced because many still maintain local roads by delegation from the County Councils, at the charge of the latter.

The expenditure in the Metropolitan area in 1932-3 was just over eight times that of 1894-5; broadly the same as that of non-County Boroughs and Urban Districts and much less than that of County Councils or of County Boroughs. Except for police, the expenditure is that only of the London district, unchanged in area and without the large population increase of other areas. The growth of the London County Council has, of course, been great, though not so unique as Londoners are apt to suppose, as the present figures show.

Comparing the relative expenditure in 1932-3 of the several classes, much of the largest proportion, 40 per cent., falls to County Borough Councils, with the County Councils next, with 21 per cent.; trading services, absent from the latter, are a large item in the former. Non-County Borough Councils account for 9 per cent. and other Urban District Councils for 8 per cent., and the Rural District Councils for not more than between 2 and 3 per cent. The Metropolitan Area provides about 14 per cent.; as previously stated, the expenditure included in this total for police is for the whole of the Metropolitan Police District. The present predominance of the two principal classes of authorities, the County Borough Councils and the County Councils, is indicated by the following table of the percentages of expenditure in three of the years, and it illustrates forcibly the trend of recent years, which would have been emphasized still more if the figures for the London County Council were added to those of County Councils :—

Year.	County Councils (excluding L.C.C.).	County Borough Councils.	Other Borough Councils.	Other Urban District Councils.	Rural District Councils.	Metropolitan Area.	All Authorities.
1894-5	8	24	7	7	3.7	12	100
1914-5	14	33	7	8	3.0	15	100
1932-3	21	40	9	8	2.4	14	100

V. Debt.

Total Debts.

Table V of the appendix contains statistics of outstanding debt, sinking funds, loan charges, proportion of loan charges to debt and capital expenditure for each tenth year from 1884-5 to 1914-15 and each subsequent year to 1932-3.

The outstanding debt was £173m. in 1884-5 and £1394m. in 1932-3, 8 times as much. The increase in the 30 years from 1884-5 to 1914-15 was $3\frac{1}{4}$ times, as compared with nearly $2\frac{1}{2}$ times in the 18 years from 1914-15 to 1932-3, in money but not in value.

The highest rate of increase in any decade was that from 1894-5 to 1904-5, an active period in local government, when the debt nearly doubled; between 1914-15 and 1924-5, the debt increased by just over one-half, but on a much larger total. There was a rise for each year in the table, except for a fall in the years of the war, from £571m. in 1914-15 to £555m. in 1919-20.

After the war there was a rapid rise and between 1919-20 and 1923-4 £265m. was added to the debt, largely because of the big expenditure on housing

The total outstanding debt is large, but it has been spent, with proportionately few exceptions, on purposes which are productive, either in direct income (as in trading concerns) or in health or in facilities (as for roads and for recreation) or in amenities, and there are large assets behind the debt. Large as is the increase in debt, the loan charges bear about the same proportion to the total expenditure on revenue account.

Alarmists sometimes sound the tocsin about the debt of local authorities and its dangers, and it is well to examine the position more closely. An indication of the nature of the debt is afforded by the services with the heaviest debt, which are as follows, the outstanding amounts being set after each service without deducting credits in sinking funds, amounting for the whole debt to over £93m. at the end of 1932-3 :—

Over £100m.—Housing, £466·8m., nearly all incurred since the war. Water, £168·6m. Electricity, £126·9m. Highways, £118·1m. Harbours, docks, piers and canals, £100·2m.

Over £50m., under £100m.—Education, £75m. Sewerage and sewage disposal, £74·8m.

Over £20m., under £50m.—Small dwellings acquisition (loans for private purchase), £47·2m. Tramways and omnibuses, £37·5m. Gas, £26·8m. Allotments and small holdings, £21·1m.

In order to carry the examination still further, in Table VI of the appendix, I have divided the several services, with the debt

for each, into four groups: (1) Trading services (which practically pay for themselves); (2) Services not classed as trading in the official returns but with large specific recoupments (rents, fees, etc.: in all these cases the recoupment is at least a third of the gross expenditure and in all but one substantially more; some also have large specific grants); (3) Services outside (1) and (2) with large specific grants (in these cases the grants were nearly 50 per cent. of the net expenditure, that is, after deducting specific recoupments); (4) Other services. The totals and percentages of debt come out as follows for these classes of services:—

				£m.	%.
Trading	...	...	...	482.5	35
With large recoupments	...	...	...	545.8	39
With large grants	...	...	...	77.5	5.5
Other services	...	...	...	287.9	20.5
Total	...	...	...	1393.7	100

The figures are not good for the alarmist. They indicate a sound position for local rates; indeed, that is a moderate statement, especially as well over 20 per cent. of the balance of charge to be met by local authorities, after deducting recoupment and specific grants, is met out of block grants and considering the assets of fundamental importance behind the debts.

The fact is that borrowing by local authorities is carefully scrutinized by Government Departments and, though less strictly, partly because not backed by independent technical advice, by Parliament.

In considering total public burden, account has to be taken, of course, of grants as well as rates, but even then the position is good.

What has been said relates to the country as a whole. Some local authorities have been hard hit by the prolonged depression and are not by any means in so happy a position and it has to be borne in mind that the value even of trading concerns depends upon the prosperity of the local area.

Capital Expenditure.

Capital expenditure was £10m. in 1884-5, and had risen to over £31m. in 1904-5; in 1914-15 it was under £22m. During the war only works which could not be avoided were carried out, but after the war, the expenditure rose rapidly, especially with the frantic haste for new houses, and reached in 1921-2 the highest figure of any year, nearly £129m., but with prices much inflated. Reaction followed and by 1923-4 the capital expenditure had fallen as low as £50m. Then it rose again, to as high as £120m. in 1927-8,

but fell to under £103m. in the next year. Afterwards there was a further rise, to nearly £117m. in 1931-2, but with an abrupt fall to under £85m. in the next year when the serious financial crisis compelled economy.

The figures of capital expenditure in the post-war years were much influenced by variations of policy in the matter of pushing forward public works in order to relieve unemployment. Whatever may be said of robbing good years in order to help the bad, and much nonsense has been written of what may be accomplished, there is little to be said for robbing future years of their normal quota of work unless there is reasonable assurance that they will be good years, though in practice sound economics may have to be tempered by other legitimate considerations.

Capital out of Revenue.

Much attention has been devoted in local government circles in recent years to providing for capital works out of revenue. The aggregate charge on the local rates would be much reduced if this were adopted, and in the past much has been done in this way by some local authorities. Theoretically, there is a good deal to be said for meeting out of revenue as much "capital expenditure" as can be reasonably foreseen year in and year out, leaving only exceptional peaks to be met out of loan. The principal difficulty is that there are large existing loan charges and the burden on ratepayers would be excessive if large sums were now raised from revenue for new capital works. The old argument of money fructifying more luxuriantly in private pockets has not much force.

What is done is to discourage the raising of loans for purposes of small cost relative to the local rateable resources; to encourage the planning of works so that about the same amount shall be spent each year and met out of revenue, where practicable as in certain kinds of road works; the levying each year of some rate, however small, for meeting capital purposes; and the preparing of a budget of capital expenditure no less than of revenue expenditure for each year, with an estimate of probable capital requirements for a number of years ahead. In a number of places something is also done in accumulating reserve funds for expenditure of a capital nature. One danger is that funds in hand or the part of the rate raised for capital purposes may be raided in times of stress or tempting political advantage.

According to the returns of local authorities, a total of £5.6m. was transferred from revenue in 1932-3 to capital accounts, and in addition an amount, which cannot be stated, was expended for capital purposes out of revenue without formal transfer.

An interesting and important development is the extent to which local authorities are providing their own capital resources, but there is not space to deal with the subject in this paper. On the 31st March, 1933, they had accumulated funds of £168·4m., of which £93·2m. were in sinking funds; £42·1m. in pension funds; £20·1m. in authorized reserve funds; £3·7m. in insurance funds; £2·3m. in trust or charity funds; and £6·9m. in other special funds.

Loan Charges.

The column in Table V of the appendix showing the proportion of loan charges to outstanding debt is instructive. Loan charges include not only interest but also sums set aside for repayment of capital. The charges in respect of a loan depend, therefore, not only on rate of interest, but also on the period for which the borrowing is authorized, the shorter the period the larger the sum to be provided each year for repayment. Housing loans are for long periods, 60 years for buildings and 80 for land, and the annual charges for these large and, in the early years costly, loans are moderated to this extent.

For total charges, in the decennial years 1884-5 to 1914-15 the percentage of loan charges varied from 5·7 in 1894-5 to 6·3 in 1914-15. From 1920-1 onwards they are at a much higher level, and varied from 7·4 per cent. in 1923-4 to 8·1 per cent. in 1927-8 and 1930-31. The percentage for the last year, 1932-3, was 7·9.

For the part of the total charges which is for payment of interest, the percentage from 1884-5 to 1914-15 varied from 3·4 in 1904-5 and 1914-15 to 4·0 in 1884-5. From 1920-1 to 1932-3, the variation was from 4·4 per cent. in 1920-21 to 4·8 in five of the years, the percentage in 1932-3 being 4·6.

For the part which was for repayment of capital, the percentage from 1884-5 to 1914-15 varied from 2·0 in the first year to 2·9 in the last. In the post-war years the lowest percentage was 2·8 in 1922-3 and the next year, and the highest 3·3 in 1932-3 and four other years.

VI. Rates.

Rate Per Head.

Table VII of the appendix contains information for 1884-5, 1894-5, 1904-5 and each year from 1913-14 of the total of values on which rates are chargeable, the average expenditure and receipts from rates and grants per head of population, the percentages in the several years of receipts from rates and grants respectively, the average rates in the £ and the relative level of rates and grants in the several years.

The total income of local authorities in 1932-3 was £441.6m., of which 33 per cent. was obtained from rates, 27½ per cent. from grants and 39½ per cent. from other specific income (charges for services, rents, etc.). It is not generally realized what a large percentage of income is derived from payments for services; but this income varies greatly in different authorities, being largest, of course, in those with trading services.

The average per head of local rates in England and Wales in 1884-5 was 19s. 1d.; in 1904-5, £1 13s. 4d.; and in 1932-3, £3 12s. 9d., which is 3½ times that of 1884-5, as compared with the growth of 6½ times in gross expenditure per head.

The estimated average for 1934-5 was £3 15s. 10d. In some post-war years the figure was higher, the highest being £4 10s. 2d in 1921-2.

The changes since the war are interesting. From 1913-14 to 1917-18 there was little change, the figures being round about £2. A rise then started, with a sudden jump in 1919-20—1920-21 from £2 16s. 4d. to £4 0s. 11d., with a further rise to the highest, £4 10s. 2d., in the next year. Then the figures began to fall, to £3 13s. 3d. in 1924-5. After that they rose again to £4 4s. 10d. in 1927-8, a height to be attributed largely, if not wholly, to the coal and general stoppage of 1926, during and after which several local authorities in the coal areas were in serious difficulties and some of them might well have gone over the precipice were it not that measures were taken for strict economy and collection of rates. These difficulties and their steady reduction are illustrated in the following particulars for distressed areas, from the annual reports of the Ministry of Health for 1930-1 and 1931-2.

Year.	No. of Authorities with rates of		
	20s. or over.	25s. or over.	30s. or over.
1927-8	73	26	7
1928-9	64	16	3
1929-30	36	10	—
1930-1	27	3	—

Of the 73 authorities with rates of 20s. or over in 1927-8, 27 were in Durham, 15 in Glamorgan and 14 in the West Riding. The revenue liabilities (debts and overdrafts) of authorities in distressed areas were reduced from £935,000 at the end of 1927-8 to £491,000 at the end of 1930-1.

After 1927-8 there was another fall in the average rate per head, slight at first then larger, to £3 12s. 9d. in 1932-3, with a rise in

1934-5 to an estimated figure of £3 15s. 10d. The figures for the post-war years indicate the changes in money values, together with expanding services and in the early years some lavishness, and gradual return to a steadier position with occasional disturbances from unsettled conditions. For a complete picture, the part played by the State must be taken into account, including services provided directly as well as the grants in aid, of which some particulars will be given later.

Rates in the £ of Chargeable Values.

The average rate in the £ was 3s. 6d. in 1884-5 (a figure on which some will look with longing !) and 10s. 10d. in 1932-3, an increase of just over 3 times, compared with the 6½ for gross expenditure per head. The average rate had risen to 6s. 11d. in 1917-18. It then increased each year until it reached 14s. 7d. in 1921-2, after which it fell, to rise again after 1924-5 until it reached 12s. 11d. in 1927-8, for reasons already stated. The estimated rate of 1931-5 was 10s. 9d., the lowest since 1919-20.

The total value of assessments on which the rates were levied rose each year, with two exceptions. In 1884-5 the total was £145.5m., in 1932-3, £269.9m., just over 1¾ times that of the former year. The two exceptions were 1922-3 to 1923-4, when a further derating of agricultural land took place, and 1929-30, when the derating under the Local Government Act of 1929 came into effect. The fall then was from £284.9m. to £255.3m. But it is noteworthy that by 1934-5 the total had passed the figure before derating (other than of agricultural land and buildings), being £285.3m. Changes in monetary values did not affect assessments to nearly the same extent as goods and services, and this fact has to be borne in mind in considering the changes in rates, as well as the obvious fact that changes in assessments fall far short of being an indication of changes in total taxable wealth.

The standard of assessments has varied at different times and in different places, the general trend being upwards. As already stated, important changes were made by the Rating and Valuation Act of 1925, the fixing of assessments was improved, with generally higher levels and closer approach to uniformity (reduction of disparities would be more exact), and the process still continues. Because of the different standards, the same rate in the £ does not necessarily mean the same at different times or places. As the levels are higher in the later years, the rates imply a heavier average charge than rates of the same amounts in earlier years. The rateable value per head being an important factor in the distribution of the block grant, it is the more necessary to aim at reasonable

uniformity of assessment. Some persons doubt whether this can be obtained under the present system, despite the substantial improvements of recent years.

Distribution of Rates.

The foregoing figures of rates are averages for the whole country. There are large differences between individual areas. This is shown by Table VIII in the appendix, taken from the Ministry of Health's "Rates and Rateable Values" of 1935, which sets out for three years the number of authorities of different classes with certain levels of rates. The following summary states the number of authorities with the rates shown in the first column.

Rates in the £.	Metro- politan Boroughs.		County Boroughs.		Other Boroughs and Urban Districts.		Rural Districts.		Total.	
	1929- 30.	1931- 32.	1929- 30.	1931- 32.	1929- 30.	1931- 32.	1929- 30.	1931- 32.	1929- 30.	1931- 32.
Under 8s. ...	—	—	4	4	4	17	50	125	58	146
8s. and over, under 10s. ...	5	16	6	8	129	201	211	230	351	455
10s. and over, under 12s. ...	15	8	16	21	308	357	226	110	565	496
12s. and over, under 14s. ...	6	3	22	17	305	235	104	49	437	304
14s. and over, under 18s. ...	3	2	30	30	226	128	52	23	311	183
18s. and over ...	—	—	5	3	66	37	10	2	81	42
Total ...	29	29	83	83	1038	975*	653	539*	1803	1626

* The large reduction in the number of urban and rural authorities is due primarily to the review of county districts required by the Local Government Act of 1929.

This table and that in the appendix present some interesting facts.

The rates differ greatly in different places. Of the 1,626 authorities in 1934-5, 601 had rates of under 10s., 225 of 14s. or more. The rates in urban areas for the year ranged from 5s. in a small urban district in a rural county to 27s. 6d. in Merthyr Tydvil, and in rural areas from 3s. 4d. in a parish in Westmorland to 25s. 3d. in an industrial parish in Carmarthenshire, including special parish rates.

The general level of rates in rural areas is, of course, lower than in urban, though not so much so as is sometimes supposed because of the many urban centres in rural areas and recent extension of services. The statistics for Rural Districts in the foregoing table relate only to the general district rate, and do not include the special

rates on parishes for special parochial services, such as water supply or sewage. These latter rates are large in some parishes. The figures in the table for Rural Districts are therefore not comparable with those for the other classes of authorities. Subject to this important qualification, of the total number of non-County Boroughs and Urban Districts 22 per cent. had rates of under 10s. and 17 per cent. rates of 14s. or more, the corresponding figures for Rural Districts, for general district rates only, being 66 per cent. and 5 per cent.

As might be expected, the general level in County Boroughs is higher than in other urban areas, with that of the Metropolitan Boroughs lower than either. The percentages of places with rates of under 10s. in County Boroughs, other Boroughs and Urban Districts and Metropolitan Boroughs were respectively 14, 22, and 55; and the percentages with rates of 14s. or more 40, 17 and 7.

The rates of 1934-5 were at substantially lower levels than those of 1929-30. This is notably so in the Metropolitan Boroughs; 16 had rates of under 10s. in 1934-5 as against 5 in 1929-30. For all authorities the percentage with rates under 10s. was 37 in 1934-5, 22 in 1929-30; the corresponding figures for places with rates of 14s. or more were 14 and 22. Higher assessments partly account for these changes, but conditions were better, and it is to be hoped also that some of the lessons of real economy learnt during the testing time in the interval have not failed of permanent effect.

VII. Grants.

Increase of Grants.

An outstanding development of local finance is the increasing extent to which means for meeting local needs have been provided from central funds. The broad facts are indicated in the following table:—

Year.	Sums provided from		Average equivalent rate in £ provided from		Average amount per head from		Percentage from	
	Rates.	Grants.	Rates.	Grants.	Rates.	Grants.	Rates.	Grants.
1884-5	£m. 25·7	£m. 3·6	s. d. 3 6	s. d. 3 6	s. d. 19 1	s. d. 2 8	87·6	12·4
1904-5	56·0	19·6	6 0	2 1	33 4	11 8	74·1	25·9
1932-3	146·3	120·5	10 10	8 11	72 9	60 0	54·8	45·2

It will be seen that out of the total provided from rates and grants, the percentage from rates fell from nearly 88 in 1884-5 to under 55 in 1932-3, while that from grants rose from just over 12 to over 45, thus fast approaching one-half. The figures are for the whole

country. There are great differences, it is right that there should be differences, in the proportion for individual authorities, and in some it exceeds 70 per cent. from grants; more particulars are given in a later section.

The reasons for this revolutionary change, carrying other changes in its train, are chiefly four.

The first is of means. Local taxation is on too narrow and inelastic a basis for modern needs, and it is doubtful if it can be other. No system of local income tax has been devised which is both productive and equitable. The earmarking of a supplement of the national income tax is but a form of central aid, and a form not commendable.

The second is of equity. Local resources differ greatly, and those authorities with low resources cannot fairly be expected themselves to meet the whole or even a large major part of the cost of modern services and standards. Nor from local resources alone would they tap wealth on which they had an equitable claim for local needs.

The third arises from modern needs and conditions. Several costly services are of a national or regional character—education, police and roads in particular. The charge for the maintenance of the unemployed has now been met almost wholly by the State. Because of closer settlement and inter-communication, old services which might have been said in earlier days to be distinctly local have taken on a wider reference.

The fourth is of stimulus. The State requires certain standards of local services, and grants are provided as incentives, and percentage grants, in particular, are therefore beloved of the reformer, and are in some respects the more suspect for that reason.

Some would add a fifth reason: that rates are a direct charge on trade and industry. Whether this be so or not—and there are some arguments on the other side—usually rates are not relatively an important item of cost, especially for industry since the 'levating of 1929, although they may bear heavily on a concern during an exceptional period of depression, because the assessments for a particular year may not reflect the condition of business in that year; and windfalls by way of unforeseen reductions are always grateful and comforting, though they may not be long when, as may happen, about an equivalent sum has sooner or later to be paid into some other pocket.

The more equitable distribution of local burdens has been sought not only by State grants but also by wider local areas for some services, the most notable recent instance being the transfer of poor relief and of the charge for certain classes of roads to the County Councils (outside County Boroughs).

Form of Grant.

The system of grants grew up in a somewhat haphazard fashion. Changes were made by the Local Government Act of 1888, chiefly by providing "assigned revenues," the allocation to local authorities of proceeds from certain taxes considered to be of a local character. The system continued until 1930. It was crude, though a reform, and was tolerable only so long as grants were not large and rates were low. Percentage grants, however, continued in addition, and increased greatly in the later years of the period. New percentage grants of first importance were made for roads, and also for a number of other services, such as maternity and child welfare, tuberculosis and venereal diseases (75 per cent. for this last), the latter grants not amounting in total to a large sum, but highly productive of results.

Agricultural land had been derated by one-half and later by a further fourth, the loss being made good to the local authorities on the first one-half by a fixed sum and on the later fourth (the local authorities having meantime learnt their lesson) by the amount of the actual loss for each year. During this period complaints were many and loud from local authorities of unfair treatment, and the blessed terms "onerous" and "beneficial" were expected to be keys for opening the money coffers of the State.

The Local Government Act of 1929 introduced a change of principle. The losses from the derating of industrial and freight-transport hereditaments and the final fourth of agricultural land with the minor percentage and other grants were pooled and an additional sum of money was added by Parliament. A formula was devised for assessing the needs of County Boroughs and Counties and for apportioning the money between them, a part of the latter's share being paid to the several County District Councils. But the full application of the formula is wisely spread over a long period, an increasing portion of the total money being so distributed by stages and the remainder divided according to losses from derating and the discontinuance of former grants, with safeguards for protecting individual authorities.

Opinions on the formula are various, but this can be said, that whatever may be its shortcomings it was a bold and necessary experiment and that it has reduced inequities. It is at present under review, provision for this purpose having been made in the Act.

The principal specific grants continue, and there are no signs that they will be superseded, as they find favour with local authorities and with enthusiasts for the particular services. In total they still much exceed the other grants (see appendix, Table IX).

The total of grants in 1932-3 was nearly £10m. less than for 1930-1, because of economy cuts necessitated by the national financial

crisis. It may be mentioned that grants in recent years for "unemployment works" were on a percentage basis as is the recent special grant for rural water schemes.

It is tempting to discuss still further this vexed question of grants-in-aid, but a volume could be filled, and I must restrict further comments to the distribution of grants between the several areas, a subject of wide interest. Some more details are given in Table IX of the appendix of the services for which specific grants are given and of the general grants, with the amounts of each, for the years 1900-1 and 1932-3.

Grants compared with Rateable Value and Rates.

Interesting information has been prepared by the Ministry of Health of the total of grants from all sources payable to County Boroughs and to all the authorities in each Administrative County and will shortly be published; the following particulars are used with permission.

A word of caution is necessary. The fair allocation of grants depends upon many factors besides levels of rateable value per head and of rates. The former is a better guide in some respects than the latter, but neither, nor both in combination, is of more value than as a presumption of need. There is, however, much instruction to be derived from the comparison of each with grants, more than is possible within the limits of this paper. The figures are for the year 1933-4.

The following tables set out the County Boroughs and the Counties with the highest and the lowest percentage of grants, five in each group. The figures after the name show respectively (A) the percentage of the total grants to the total of rates and grants, (B) the rateable value per head, and (C) the rate required to meet the rate-borne expenditure of the year (which may not be exactly the rate levied for the year).

County Boroughs.

Highest :—				A.	B.	C.
				%	£	s. d.
South Shields	...	...	...	57.7	4.3	12 1
St. Helens	...	...	...	55.5	3.8	17 0
Middlesbrough	...	...	...	53.9	4.5	13 11
Dudley	...	...	...	53.3	3.7	16 7
West Bromwich	...	...	...	53.1	3.8	15 6
Lowest —						
Blackpool	..	...	...	25.6	13.4	7 7
Croydon	..	...	...	24.8	8.7	10 1
Southend	..	...	...	21.1	10.3	10 9
Eastbourne	..	...	...	21.0	14.7	7 10
Bournemouth	...	...	...	14.2	14.3	7 10

(In West Bromwich, Croydon and Bournemouth the police service is administered by another authority.)

The five County Boroughs with the highest rates in the year were: Merthyr Tydvil (25s. 11d; grant, 50·3 per cent.); Norwich (20s. 3d.; 37·2 per cent.); West Ham (19s. 8d.; 42·2 per cent.); Hull (17s. 5d.; 39·7 per cent.); Salford (17s. 1d.; 42·9 per cent.); none of these is in the table of the highest five percentages of grant.

The five County Boroughs with the lowest rates were Blackpool, Eastbourne and Bournemouth, all of which are in the table of lowest percentages of grant, with Southport (8s. 4d.; 27·4 per cent.) and Oxford (8s. 4d.; 33·6 per cent.):

		<i>Counties.</i>		
Highest:—		<i>A.</i>	<i>B.</i>	<i>C.</i>
		%	£	s. d.
Huntingdon ...	...	77·0	3·5	8 0
Isle of Ely ...	...	73·6	3·3	10 1
Montgomery ...	...	72·7	3·4	10 0
Rutland ...	...	71·9	4·5	9 10
Cumberland ...	...	69·5	3·8	12 6
Lowest:—				
Kent ...	...	42·5	7·3	10 6
Essex ...	...	42·1	6·1	13 0
West Sussex ...	...	40·9	8·1	9 4
Middlesex ...	...	34·8	9·0	10 4
Surrey ...	...	34·0	9·8	8 10

Both sets of tables indicate a fairly close relation between grants and rateable values, with some exceptions, but not much between grants and rates. It will be seen that seaside resorts and the Home Counties predominate in the groups of lowest grant.

London is in a special position and is not included in the above figures. Its percentage of grant was 29·8, its rateable value per head nearly £14 and its average rate 10s.

The foregoing figures provide no more than an indication, and it is well to examine the position more closely. The following tables indicate the correlation for all the County Boroughs and Counties.

County Boroughs.

Rate of Grant.	Rateable value per head, £s.						Total.
	3-4.	4-5.	5-6.	6-7.	7-8.	8 and over.	
50 per cent. and over ...	4	4	1	—	—	—	9
45-50 per cent.*	1	8	4	4	—	—	17
40-45 per cent.	—	1	15	7	—	—	23
35-40 per cent.	—	—	4	6	7	5	22
Under 35 per cent. ...	—	1	1	—	—	10	12
Total ...	5	14	25	17	7	15	83

* That is, 45 per cent. and over, under 50 per cent.; and similarly in other cases.

There is no special virtue in the groupings adopted, but they are convenient and present a fair picture.

The lower the rateable value per head the higher should be the rate of grant, other things being equal, if the grant is to be proportionate to needs. The above table shows fairly good correlation. Rateable value per head is an important item in the formula for distributing the block grant, but only part of that grant is at present distributed according to the formula, and percentage or other specific grants, which are a large proportion of the whole, take no direct account of it except in a measure in the grants for education.

Counties (other than London).

Rate of Grant.	Rateable value per head, £s.					Total.
	Under 4.	4-5.	5-6.	6-7.	7 and over.	
Over 70 per cent. ...	3	1	—	—	—	4
60-70 per cent. ...	13	9	1	—	—	23
50-60 per cent. ...	2	10	6	4	—	22
40-50 per cent. ...	—	1	1	4	4	10
Under 40 per cent. ...	—	—	—	—	2	2
Total ...	18	21	8	8	6	61

The correlation here also is fairly good, though not so good as that for County Boroughs. This is to be expected because Counties differ more than County Boroughs in needs for local services, particularly because of differences in the proportion of agricultural land and of areas of concentrated development.

The following tables deal with the relation of grants to rates:—

County Boroughs.

Grant.	Rates in the £.					Total.
	17s. 6d. and over.	15s. to 17s. 6d.	12s. to 15s.	10s. to 12s.	Under 10s.	
50 per cent. and over ...	1	3	4	1	—	9
45-50 per cent. ...	—	5	7	3	2	17
40-45 per cent. ...	1	5	12	5	—	23
35-40 per cent. ...	1	4	6	8	3	22
Under 35 per cent. ...	—	2	—	4	6	12
Total ...	3	19	29	21	11	83

Counties.

Grant.	Rates in the £.				Total.
	15s. and over.	12s. to 15s.	10s. to 12s.	Under 10s.	
Over 70 per cent....	—	—	2	2	4
60–70 per cent. ...	4	7	10	2	23
50–60 per cent. ...	1	6	11	4	22
40–50 per cent. ...	—	3	3	4	10
Under 40 per cent.	—	—	1	1	2
Total ...	5	16	27	13	61

There is much less correlation between grants and rates than between grants and rateable value per head. This, too, is to be expected. The levels of rates depend upon many factors, such as—the standard of administration; the new burden of expensive public works, making the debt burden heavier in towns of more recent date or with fresh large growths in areas not previously provided with public works; topography, which for instance goes to make administration more costly in the hill towns of South Wales (an industry would be parasitic if it did not produce a sufficient surplus to meet the additional cost); local habits, such as the thriftiness of Lancashire cotton towns; and there are still differences in standard of assessments, though less than before the Rating and Valuation Act of 1925 came into effect. The distribution of grants according to rates would be wrong in principle, besides weakening local responsibility.

It is unlikely that the needs of the distressed areas could be properly met by any revised distribution of the block grant, if it were decided to afford them further assistance. Indeed, it would be wrong in principle to weight ordinary grants to meet exceptional needs—needs which, it is to be hoped, will pass, at least in their present intensity. The issue is also complicated by local standards of administration.

The local authorities are already in effect relieved of all the charge for the able-bodied in need who are within the Contributory Pensions Act of 1925, though by a temporary arrangement for the able-bodied still under the poor law; some special consideration is given to areas with low resources in the grants for education; and some exceptional assistance is given in various ways through the Commissioner for the Special Areas.

The general level of grants is higher in the Counties than in the County Boroughs. This is shown by the following table, which sets

out the number of Counties and County Boroughs with rates of grants as indicated in the first column.

Grant.	No. of	
	Counties.	County Boroughs.
70 per cent. and over ...	4	—
60-70 per cent. ...	23	—
50-60 per cent. ...	22	9
40-50 per cent. ...	10	40
Under 40 per cent. ...	2	34
Total ...	61	83

This difference arises from the different circumstances. Rates are not now paid on agricultural land. The block grant is weighted for sparsity of population, among other factors. The rateable value per head is lower in the Counties than in the County Boroughs. Out of the 61 former, 39 have under £5 a head and only 6 over £7; the corresponding figures for the latter are 19 and 22 out of 83.

In considering the grants for the Counties, it has to be borne in mind that, as previously stated, they are the grants lumped together for all the authorities in the County. There are large differences in the proportion of grants received by the several authorities within the County. The specific grants are paid to the authorities carrying out the service for which each is given, broadly in proportion, directly or otherwise, to expenditure. Out of the block grant apportioned for each Administrative County, a share is paid to each non-County Borough, Urban District and Rural District (with small additional amounts for some parishes), the payment to the two former being 12s. 6d. per head of population in the first grant period, irrespective of rateable value or rates, and to the latter (Rural Districts) a fifth of that amount. Each area also benefits, of course, from the balance of the County Apportionment paid to the County Council towards reducing its demands on the areas.

VIII. Summary.

I have set out some of the more important facts to be borne in mind in interpreting statistics of local finance, including the great expansion of functions, the larger proportion of the population living in urban areas, the many alterations in local government areas and classes of authorities, the striking changes between local and central finance and the better assessment of properties, as well as the changed value of money.

The gross expenditure per head of population on revenue account in 1932-3 was nearly $6\frac{1}{2}$ times that of 1884-5, just over $3\frac{1}{4}$ times that of 1904-5, and nearly $2\frac{1}{2}$ times that of 1914-15 (at a rough guess, under $1\frac{3}{4}$ times, allowing for changed value of money). The rate of increase was especially large in the decades 1894-5 to 1904-5 and 1914-15 to 1924-5 (but in the latter much is due to the changed value of money).

The service with the largest increase, 78 times from 1884-5 to 1932-3, was housing, but the expenditure in 1884-5 and even in 1914-15 was comparatively trifling. The expenditure on the different classes of schemes is examined, with the large charge on the National Exchaquer.

Next comes education, with an increase of 14 times in the period; the big jump in education took place after the passing of the Education Act of 1902. In all the other services the increases were much less, varying from $2\frac{1}{2}$ times for miscellaneous services to $8\frac{1}{2}$ times for trading services, but the expenditure on public health was not separately stated in 1884-5; between 1904-5 and 1932-3 the expenditure in this service increased to $3\frac{3}{4}$ times. It is noteworthy that the expenditure on poor relief increased to not far short of 3 times in 1884-5 to 1932-3 despite the large national expenditure on social services. Loan charges increased in about the same proportion as other expenditure.

Comparing the expenditure of the several classes of authorities, the outstanding fact is the large increase in the expenditure of County Councils and, in less degree, of County Borough Councils. In 1894-5 the two together (excluding the London County Council) accounted for 32 per cent. of the total revenue expenditure of Local Authorities; in 1932-3, 61 per cent., of which 40 per cent. was for County Borough Councils and 21 per cent. for County Councils.

The gross debt increased to 8 times in 1884-5 to 1932-3 (without allowing for sinking funds, which increased from just over 1 per cent. to over $6\frac{1}{2}$ per cent. of the gross outstanding debt). The service with much the heaviest debt was again housing, followed by water (with just over a third of the debt of housing), electricity and highways. Thirty-five per cent. of the total debt was for trading services, which as a whole practically pay their way, another nearly 45 per cent. was for services where large receipts are received from charges and other recoupments or from specific grants, leaving only from 20 to 21 per cent. for other services, and even for the balance of burden falling on local authorities large grants are received. The position as a whole is considered eminently sound. Loan charges and capital expenditure in the course of the years are examined, and reference

is made to payment from revenue of the cost of "capital works" and the accumulation of capital funds by local authorities.

The average rate in the £ in 1932-3 was about 3 times, and the average amount of rates per head of population about $3\frac{3}{4}$ times, those in 1884-5. Assessments are generally on a higher level in recent years. Rates differ greatly among local authorities; out of the 1,087 urban authorities in 1934-5, 246 had rates of under 10s. and 200 had rates of 14s. or more.

Of the total received in rates and grants, the percentage received in grants rose from under $12\frac{1}{2}$ in 1884-5 to nearly 26 in 1904-5 and over 45 in 1932-3. The reasons for this great change are considered. The proportion of grants differs much for the several authorities, and would differ much even if a perfect system were devised. In County Boroughs they varied from just under 58 per cent. to just over 14 per cent. In Administrative Counties, for County Councils and all other authorities within the County, the levels of grants are higher, for good reasons, and varied from 77 per cent. to 34 per cent. The relation of grants to rateable values and to rates is examined.

Three other matters may be mentioned in conclusion. Praise is due to the Ministry of Health for the improved form in which local statistics are issued; more still needs to be done, for the expert and for the layman, and measures to this end are likely to be supported by the present Minister, with his flair for public information. The services and quality of the local treasurers and accountants have risen in marked degree, and their Institute is among the most active and progressive of local government organizations. Lastly, more attention to local statistics is needed from those learned in the magic of figures, for extracting their lessons and for improving their form and use.

APPENDIX.

TABLE I.

Gross Total Expenditure of Local Authorities in England and Wales : 1884-5 to 1932-3.

£000,000's.

Service.	1884-5.	1894-5.	1904-5.	1914-5.	1921-5.	1930-1.	1931-2.	1932-3.
Education... ..	3.9	7.8	22.1	32.8	73.9	86.6	85.1	82.6
Highways	6.7	9.3	13.5	17.7	45.8	52.4	51.9	46.8
Public Health	—	—	10.1	14.1	32.8	42.5	45.1	46.1
Housing	0.3	0.3	0.5	0.9	17.5	35.2	37.3	39.0
Poor Relief	7.4	8.5	11.5	12.9	31.4	32.0	30.4	32.7
Police	3.5	4.7	6.1	8.2	19.2	22.3	22.3	21.5
Lunacy	1.7	2.0	3.4	4.6	8.1	9.0	8.8	8.8
Miscellaneous	12.0	15.5	18.1	19.8	37.6	46.0	46.2	44.6
Total	35.5	48.1	85.3	111.0	266.3	326.0	327.1	322.1
Principal Trading Services... ..	8.6	11.6	22.4	42.3	88.6	106.7	107.9	108.2
Grand Total Expenditure other than out of Loan	44.1	59.7	107.7	153.3	354.9	432.7	435.0	430.3
Expenditure out of Loan	10.4	13.4	31.4	21.8	70.3	110.9	116.8	84.8
Grand Total of all Expenditure	54.5	73.1	139.1	175.1	425.2	543.6	551.8	515.1

Notes.—In earlier years, loan charges were not apportioned to all the several services, and the apportionment has therefore had to be estimated.

Expenditure on public health was not given separately for 1884-5 and 1894-5 and is included in "miscellaneous."

Expenditure on assisting private persons to acquire small dwellings is not included in the figures for housing.

"Miscellaneous" includes trading as well as general services not separately stated in the table. The "Principal Trading Services" for which separate figures are given are—water, electricity, gas, tramways and omnibuses and harbours, docks, piers and canals.

The figures for 1930-1 to 1932-3 relating to expenditure other than out of loan are exclusive of capital expenditure met out of government grants or out of other receipts of a capital nature, as well as of expenditure met out of loans. The earlier figures exclude only expenditure met out of loans. This does not make much difference.

TABLE II.

*Gross Expenditure, other than out of Loan, of Local Authorities.
Average Amount per Head of Population 1884-5 to 1932-3.*

Service.	1884-5.	1894-5.	1904-5.	1914-15.	1924-5.	1930-1.	1932-3.
	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>
Education ...	2 11	5 2	13 2	17 9	38 2	43 6	41 1
Highways ...	4 11	6 2	8 1	9 7	23 8	26 4	23 3
Public health ...	—	—	6 0	7 8	16 11	21 4	22 11
Housing ...	0 3	0 2	0 4	0 6	9 1	17 8	19 5
Poor relief ...	5 7	5 8	6 10	7 0	16 3	16 1	16 3
Police ...	2 7	3 1	3 7	4 5	9 10	11 2	10 8
Lunacy ...	1 3	1 4	2 0	2 6	4 2	4 6	4 5
Miscellaneous	8 11	10 3	10 9	10 9	19 4	23 1	22 3
Total ...	26 5	31 10	50 9	60 2	137 5	163 8	160 3
Principal trading ...	6 5	7 8	13 4	22 11	45 9	53 8	53 10
	32 10	39 6	64 1	83 1	183 2	217 4	214 1

Notes.—See notes to table I.

TABLE III.

Expenditure of all Local Authorities in England and Wales per Head of Estimated Population, other than out of Loan, distinguishing the Amounts in respect of the Principal Services.

Services.	1884-5.	1894-5.	1901-5.	1914-15.	1924-5.	1932-3.
	s.	s.	s.	s.	s.	s.
(1) Expenditure other than loan charges.						
(a) General Services :						
Elementary Education ...	2.1	4.3	10.1	12.9	28.8	29.0
Higher Education ...	0.1	0.2	1.5	2.8	7.1	9.1
Libraries and museums ...	0.1	0.2	0.4	0.3	0.8	1.0
Public Health :						
Sewers and sewage disposal works ...	0.7	0.9	1.2	1.1	2.5	2.6
Collection and disposal of house refuse ...	"	"	1.3	1.1	3.2	3.3
Baths, washhouses, etc. ...	0.1	0.1	0.3	0.3	0.7	0.9
Parks and other open spaces	0.1	0.3	0.4	0.6	1.7	1.9
Maternity and child welfare	†	†	†	0.0	0.9	1.5
Hospitals, sanatoria, etc. :						
Tuberculosis ...	†	†	†	0.2	1.4	1.6
Venereal diseases ...	†	†	†	†	0.2	0.2
Other diseases ...	0.1	0.3	0.8	1.1	1.5	3.4
Other public health purposes	"	"	0.2	0.3	1.6	2.6
Relief of the poor † ...	5.0	5.1	6.2	6.3	15.8	15.9
Housing (other than small dwellings acquisition) ...	0.1	0.0	0.1	0.1	2.1	5.1
Highways, bridges and ferries (including scavenging) ...	4.2	4.9	6.3	7.4	21.0	18.7
Public lighting ...	0.7	0.7	1.2	1.2	1.9	2.3
Police and police stations ...	2.6	3.1	3.5	4.3	9.8	10.6
Mental hospitals and mental deficiency ...	1.1	1.2	1.7	2.0	4.3	5.1
Other services ...	4.7	5.3	6.4	6.6	10.3	11.0
(b) Trading services :						
Water ...	0.6	0.7	1.0	2.0	4.2	4.9
Gas ...	1.8	2.4	3.1	3.8	7.6	6.6
Electricity ...	"	0.1	0.6	1.6	6.5	10.7
Tramways, etc. ...	0.0	0.1	2.1	4.2	10.0	10.9
Cemeteries ...	0.2	0.2	0.2	0.3	0.6	0.7
Harbours, docks, piers and canals ...	0.8	1.0	1.2	2.7	5.1	3.8
Markets ...	0.2	0.2	0.3	0.3	0.6	0.7
General Corporation estates ...	"	"	"	"	0.1	0.3
Miscellaneous trading services...	—	—	—	—	0.3	0.9
(2) Loan charges in respect of all services ...	7.3	8.5	11.1	19.1	31.7	48.5
Totals ...	32.8	39.6	61.2	83.1	183.2	214.1

* Amounts not distinguished in printed returns.

† Service not commenced by local authorities.

‡ Including for 1884-5 and 1894-5 expenditure on fever and smallpox hospitals belonging to the Managers of the Metropolitan Asylum District.

TABLE IV.

Expenditure other than out of Loan (with Loan Charges allocated to the Several Services).

Local Authorities in England and Wales.

Services.	Total expenditure per head of population.		
	1913-14.	1921-5.	1932-3.
	£ s. d.	£ s. d.	£ s. d.
(1) General Services.			
Education :			
Elementary Education (including Industrial Schools)	14 4	1 10 4	1 11 1
Higher Education	3 0	7 10	10 0
Total Education	£0 17 4	£1 18 2	£2 1 1
Public libraries and museums	5	10	1 1
Public Health :			
Sewers and sewage disposal	3 0	4 6	5 6
Collection and disposal of house refuse	1 6	3 5	3 6
Hospitals, sanatoria, dispensaries, etc. :			
For tuberculosis	3	1 6	1 10
For venereal diseases	—	2	3
For other diseases (fever, diphtheria, smallpox, etc.)	1 1	1 8	1 8
General Hospitals	—	—	2 0
Maternity and child welfare	—	11	1 6
Baths, washhouses and open bathing places	6	10	1 2
Parks and other open spaces	11	2 2	2 8
Other public health services	4	1 9	2 10
Total Public Health	£0 7 7	£0 16 11	£1 2 11
Lunacy and mental deficiency	2 5	4 8	5 6
Housing and town planning	6	9 4	1 0 9
Relief of the poor (excluding maintenance of rate-aided patients in mental hospitals)	6 9	16 3	16 3
Highways and bridges (excluding lighting but including scavenging)	9 4	1 3 8	1 3 3
Private street works and other works of private improvement	8	10	1 1
Public lighting (lighting streets, etc.)	1 3	1 11	2 4
Fire brigades	5	1 0	1 2
Police and police stations	4 2	9 10	10 9
Administration of Justice	6	8	9
Land drainage and river conservancy and embankment	3	6	9
Small holdings and allotments	3	1 2	1 1
Other works and purposes	3 2	2 5	3 8
(2) Trading Services.			
Cemeteries	5	8	10
Markets	6	10	1 0
Water	5 0	8 2	9 9
Gas	4 8	8 9	8 0
Electricity	2 10	9 10	17 0
Tramways, etc.	5 6	11 7	13 0
Harbours, docks, piers, canals, etc.	4 5	7 4	6 1
Other trading services (including Corporation estates and ferries)	†	1 2	1 9
(3) Expenditure so far as not allocated in the returns to specified services	2 9	6 8	4 3
Totals (per head)	£1 1 1	£9 3 2	£10 14 1
Totals (£)	£148,239,000	£354,926,000	£130,320,000
Estimated population	36,574,000	38,746,000	40,201,000

* Expenditure on maternity and child welfare was not shown separately in the Local Taxation Returns for 1913-14.

† For 1913-14 expenditure on "other trading services" is included in the 3s. 2d. for "other works and purposes" included above under General Services.

The figures for 1913-14 and 1921-5 may include some "capital expenditure" not met out of loans of a kind excluded from the figures for 1932-3, but this does not make a material difference.

TABLE V.

Debt, Loan Charges, Capital Expenditure. All Local Authorities in England and Wales.

Year.	Gross out-standing loan debt at end of year.	Amount standing to credit of Sinking Funds at end of year.	Loan charges.	Proportion of loan charges to outstanding loan debt at beginning of year.			Capital expenditure during year "
				Total.	Interest on Loans.	Provision for repayment.	
	£m.	£m.	£m.	%.	%	%	£m.
1884-5	173.2	2.0	9.9	6.0	4.0	2.0	10.4
1894-5	234.5	5.3	12.7	5.7	3.6	2.1	13.4
1904-5	462.9	15.0	23.7	6.0	3.4	2.6	31.4
1914-15	570.8	37.5	35.3	6.3	3.4	2.9	21.8
1919-20	555.1	59.9	37.8	6.9	3.7	3.2	23.9
1920-21	657.8	62.3	41.7	7.5	4.4	3.1	94.5
1921-2	768.6	64.6	51.5	7.8	4.8	3.0	128.7
1922-3	803.9	62.4	57.6	7.5	4.7	2.8	71.6
1923-4	820.3	61.8	59.8	7.4	4.6	2.8	50.0
1924-5	864.9	63.1	61.5	7.5	4.6	2.9	70.3
1925-6	934.7	62.8	68.8	8.0	4.7	3.3	100.7
1926-7	1,027.9	67.8	74.2	8.0	4.8	3.2	117.4
1927-8	1,121.3	69.8	83.4	8.1	4.8	3.3	120.0
1928-9	1,175.0	67.6	89.4	8.0	4.7	3.3	102.8
1929-30	1,224.7	66.8	93.2	8.0	4.8	3.2	108.9
1930-31	1,303.8	88.5	99.6	8.1	4.8	3.3	110.9
1931-2	1,356.8	91.1	102.1	7.8	4.6	3.2	116.8
1932-3	1,393.6	93.3	106.7	7.9	4.6	3.3	84.8

* For years 1884-5 to 1927-8, inclusive, the figures represent expenditure only out of loans. Other capital expenditure was included in "Expenditure other than out of loans."

TABLE VI.

Outstanding Debt at 31st March, 1933.

T = Services classed as trading in the tables of the Ministry of Health.

R = Other services with specific recoupments (rents, charges, etc.) of at least one-third.

G = Services not included above where the specific grant is almost one-half of net expenditure.

O = Other services.

£100,000's.

Service.	T.	R.	G.	O.
Housing :				
Under Act of 1919	—	170.7	—	—
Other State-aided	—	279.6	—	—
Other	—	16.5	—	—
Total	—	466.8	—	—
Water	168.6	—	—	—
Electricity	126.9	—	—	—
Highways	—	—	—	118.1
Harbours, docks, piers, canals	100.2	—	—	—
Education :				
Elementary	—	—	53.5	—
Higher	—	—	21.5	—
Total	—	—	75.0	—
Sewerage and sewerage disposal	—	—	—	71.8
Small dwellings acquisition	—	47.2	—	—
Tramways and omnibuses	37.5	—	—	—
Gas	26.8	—	—	—
Allotments and small holdings	—	21.1	—	—
Parks and other open spaces	—	—	—	18.4
Mental hospitals	—	—	—	9.3
Markets	8.7	—	—	—
Land drainage, sea defences, etc.	—	—	—	8.1
General corporation estates	6.9	—	—	—
Relief of the poor	—	—	—	6.9
Baths, washhouses	—	6.1	—	—
Miscellaneous health services	—	—	—	4.1
Hospitals, etc., for infectious diseases	—	—	—	3.5
Fire Brigades	—	—	—	3.3
Collection and disposal of house refuse	—	—	—	2.9
Sanatoria, etc., for tuberculosis	—	—	—	2.8
Cemeteries	2.7	—	—	—
Police	—	—	2.5	—
Mental deficiency	—	—	—	2.5
General hospitals	—	—	—	2.4
Private street works, etc.	—	2.1	—	—
Ferries	1.7	—	—	—
Libraries and museums	—	—	—	1.6
Public conveniences	—	1.3	—	—
Miscellaneous	2.5	0.9	—	29.2
Totals	482.5	515.8	77.5	287.9
Grand Total		1,393.7		

Notes.—Of the figures in column R, the specific recoupment was 60 per cent. of the total expenditure on revenue account for housing (43 per cent. on the 1919 Act houses, 67 per cent. on other State-aided houses, and 87 per cent. on other houses); on small dwellings acquisition, 100 per cent.; on allotments and small holdings, 58 per cent.; on baths and washhouses, 46 per cent.; on private street works, etc. 100 per cent.; on the part of "miscellaneous" services (administration of justice) included in this column, 40 per cent.; and on public conveniences, 36 per cent.

Of the figures in column G, the specific grants for education were £38.8m. out of a net revenue expenditure (that is, after deducting fees and other recoupments) of £78.4 m.; for police, £10.1m. out of £20.8m. Large specific grants were given also for housing, £12.7m. out of a net expenditure of £15.7m.; for allotments and small holdings, almost the whole net expenditure; and for highways, £8.9m. out of £14.4m. Substantial specific grants were given for several other services, chiefly for "unemployment works," the total of specific grants for all services, other than trading, being £73.5m. out of a total net expenditure of £267.8m., over 27 per cent.

TABLE VII.
Comparison of Rates and Grants.

Year.	Population.	Values on which rates chargeable.	Average Gross Expenditure per head on revenue account.		Average amount per head received from				Percentage of total of rates and grants received from		Average rates in the £ collected.	Level of (1914 = 100)	
			£ s. d.	£ s. d.	Rates.	Grants.	Total.	Rates.	Grants.	Rates in the £.		Grants in the £.	
1884-5	26,923	£200,000's	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	%	%	s. d.	52	23
1885-6	26,923	145-5	0 19 1	0 2 8	0 19 1	0 2 8	1 19 4	87-6	19-4	21-0	4 2	62	50
1894-5	30,104	161-1	1 2 6	0 6 0	1 2 6	0 6 0	1 8 6	79-0	21-0	25-9	6 0	89	86
1904-5	33,639	187-5	1 13 4	0 11 8	1 13 4	0 11 8	2 5 0	74-1	25-9	24-1	6 8½	100	100
1913-14	36,574	211-6	1 18 11	0 12 4	1 18 11	0 12 4	2 11 3	75-9	24-1	23-9	6 10½	102	100
1914-15	36,967	214-3	1 19 11	0 12 6	1 19 11	0 12 6	2 12 5	76-1	23-9				
1915-16	35,284	216-4	2 0 8	0 13 3	2 0 8	0 13 3	2 13 11	76-5	23-5				
1916-17	34,642	217-1	1 18 10	0 13 2	1 18 10	0 13 2	2 12 0	76-1	23-9				
1917-18	34,137	218-6	2 0 1	0 15 5	2 0 1	0 15 5	2 15 6	74-1	25-9	6 10½	102	112	112
1918-19	34,024	219-7	2 5 2	0 17 0	2 5 2	0 17 0	3 2 2	71-6	25-1	7 8½	113	123	123
1919-20	36,427	220-7	2 16 4	1 7 3	2 16 4	1 7 3	1 3 7	68-6	31-4	9 6½	112	200	200
1920-1	37,247	223-7	4 0 11	1 13 10	4 0 11	1 13 10	5 14 9	70-7	29-3	13 7	202	263	263
1921-2	37,886	234-0	4 19 2	2 0 6	4 19 2	2 0 6	6 10 8	69-0	31-0	14 7½	217	304	304
1922-3	38,158	236-1	4 2 5	1 19 9	4 2 5	1 19 9	6 2 2	67-5	32-5	13 1½	195	292	292
1923-4	38,403	236-5	3 14 7	2 0 10	3 14 7	2 0 10	5 15 5	61-7	32-3	12 1½	180	304	304
1924-5	38,746	242-0	3 13 3	2 2 2	3 13 3	2 2 2	5 13 5	63-6	36-5	11 8½	174	312	312
1925-6	38,890	246-8	3 16 5	2 3 6	3 16 5	2 3 6	5 19 11	65-7	36-3	12 0½	179	315	315
1926-7	39,067	256-1	4 1 5	2 4 6	4 1 5	2 4 6	6 5 11	64-6	35-4	12 5	185	312	312
1927-8	39,290	258-0	4 4 10	2 5 10	4 4 10	2 5 10	6 10 8	64-0	35-1	12 10½	191	323	323
1928-9	39,432	267-6	4 4 4	2 5 5	4 4 4	2 5 5	6 9 7	65-1	34-9	12 5½	185	308	308
1929-30	39,607	284-9	3 18 11	2 14 5	3 18 11	2 14 5	6 13 4	50-2	40-8	11 6½	172	350	350
1930-1	39,806	237-4	10 17 6	3 15 4	3 15 4	3 3 3	7 0 9	53-5	46-5	11 7½	173	465	465
1931-2	39,968	265-3	3 14 3	3 3 3	3 14 3	3 3 3	6 17 6	34-0	46-0	11 2½	166	488	488
1932-3	40,201	270-0	3 12 9	3 0 0	3 12 9	3 0 0	6 13 9	54-8	45-2	10 10	161	462	462
1933-4	40,350	274-2	3 13 6	3 0 3	3 13 6	3 0 3	6 13 9	54-8	45-2	10 9½	160	468	468
1934-5	40,467	285-3	3 15 10	—	3 15 10	—	—	—	—	10 8½	159	—	—

Notes.—Population. This is the estimated population at the middle of the year. The estimates for the years 1913-16 to 1920-1 are for the civil population only, and are therefore not strictly comparable with those of other years.

1929-30. The figure of £28 m. in the third column (values on which rates chargeable) is the total of chargeable values on April, 1929, which excludes agricultural land and buildings of less than £200. The figure of £28 m. in the third column (values on which rates chargeable) is the total of chargeable values on April, 1929, which excludes agricultural land and buildings of less than £200. The figure of £28 m. in the third column (values on which rates chargeable) is the total of chargeable values on April, 1929, which excludes agricultural land and buildings of less than £200. The figure of £28 m. in the third column (values on which rates chargeable) is the total of chargeable values on April, 1929, which excludes agricultural land and buildings of less than £200.

1932-4 and 1933-5. All the figures for these years are estimated from preliminary returns made to the Ministry of Health, but are not likely to be materially different from the actual figures. Figures were not yet available for the blank spaces in 1934-5.

Rates. The figures are of rates collected, not rates levied. The rates levied are higher (to provide for compounding allowances, losses, etc., including in some places discount for prompt payment). For example, the average rate levied in 1924-5 was 12s. 4½d. as against 11s. 8½d. collected, and the figures for 1932-3 were 11s. 7d. and 10s. 10d.

TABLE VIII.

Distribution of Rates.

(From Ministry of Health " Rates and Rateable Values
England and Wales " of 1935.)

Rates.	Number of areas with rates as indicated in the first column.											
	Metropolitan Boroughs.			County Boroughs.			Other Boroughs and Urban Districts.			Rural Districts.		
	1929- 30.	1933- 4.	1934- 5.	1929- 30.	1933- 4.	1934- 5.	1929- 30.	1933- 4.	1934- 5.	1929- 30.	1933- 4.	1934- 5.
Under 6s. ...	—	—	—	—	—	—	—	2	1	1	10	3
6s. and under 8s.	—	—	—	4	4	4	4	22	16	10	156	122
8s. " 10s.	5	13	16	6	8	8	129	222	201	211	260	230
10s. " 12s.	15	9	8	16	21	21	308	362	357	226	94	110
12s. " 14s.	6	4	3	22	20	17	305	240	235	101	51	49
14s. " 16s.	1	2	1	15	17	21	166	93	86	42	23	16
16s. " 18s.	2	1	1	15	9	9	60	41	42	10	5	7
18s. " 20s.	—	—	—	4	3	2	28	13	18	5	—	1
20s. and over ...	—	—	—	1	1	1	38	17	19	5	1	1
	29	29	29	83	83	83	1038	1012	975	653	600	539

Note.—The rates for the Metropolitan Boroughs, the County Boroughs and other Boroughs and Urban Districts are those for all purposes (but not water, which is a charge for service), but the rates for Rural Districts are for general district purposes only and do not include the rates levied for special parish services.

TABLE IX.

*Government Grants on Revenue Account.**All Local Authorities in England and Wales.*

£000's.

	1900-1.	1932-3.
Grants for specific services :		
Education :		
Elementary	3,927	30,568
Higher... ..	1,098	8,204
	5,025	38,772
Housing :		
Under Act of 1919	—	6,601
Other State-aided	—	6,128
Other	—	2
	—	12,731
Police	2,241	10,068
Highways	—	8,923
Port sanitary service	2	34
Allotments and small holdings	—	858
Registration of electors	—	288
Salaries of Medical Officers of Health, etc.	153	—
Miscellaneous	1,810	2,459 *
	9,231	74,133
Other Grants :		
Under Agricultural Rates Act, 1896 ...	1,330	—
Free balances of Exchequer Contribu- tion Accounts	2,095	—
Local Taxation Licence Duties	†	1,388
Block grants	—	44,969
Remnants of discontinued grants ...	—	42
Totals	12,656	120,532

* Nearly all the grants included against "Miscellaneous" for 1932-3 were in respect of works specially assisted to relieve unemployment.

† Local Taxation Licence Duties for the year 1900-1 are included against other items.

DISCUSSION ON SIR GWILYM GIBBON'S PAPER.

MR. F. W. RATTENBURY: If any of you have ever had the courage to beard the reader of this paper in his den at the Ministry of Health, you must have left him with the impression on your mind that there should have been affixed to the door of his room that little notice with which those of us who live in suburban residences are so familiar: "No hawkers; no circulars." There was an occasion when I thought it ought to be supplemented by "Beware of the dog"; but that is another matter. What I am alluding to is this, that Sir Gwilym has very little patience with a person who does not deliver the goods, he being of that nature and temperament which insists upon the real thing and nothing else. In this respect he has set us in the municipal service a wonderful example over a period of years, and I thank you, Mr. President, for giving me the opportunity to pay this tribute to him.

The Society was good enough to send me an advance proof of this paper, and I handed it to my statistical assistant and asked him to provide me with shot and shell; I burned the midnight oil, but our combined efforts have not produced any ammunition.

Sir Gwilym on this occasion has not been controversial or provocative—how he has mellowed!—but he has given us a paper which without a doubt will be regarded by those of us who are now, and will remain for many years to come, in the municipal service, as a work of reference which will be very useful.

In his reference to *thé* expenditure on education, he says: "This vast growth in expenditure raises the question whether value is being obtained in return. I do not know, and I do not know that anyone knows, though faith abounds."

Under the heading of *Public Health Expenditure*, he says: "It is simpler in public health than in several other services to obtain objective tests of results, and the figures of mortality of different groups and from diseases tell of an excellent record, though these are not of themselves sufficient, and other causes besides the work of local authorities have contributed their share. There are few subjects which more merit investigation than better objective tests of the return obtained from the labours and expenditure of public bodies." As he has suggested in his remarks, are we getting value for our money? Many of us engaged in municipal finance have asked ourselves that question.

I realize that I speak in the presence of many eminent statisticians, but I have the courage to suggest that the difficulties to be met with in such a test are wellnigh insuperable. The great increase in expenditure on social services has been since the War; we know the pre-war argument about the inequalities in the distribution of wealth; we know that since the War the wealth of the community has most certainly been more evenly distributed, and this has largely been brought about by expenditure on the social services. If comparison be made between the post-war conditions in this country of ours and those in others, we can, I think, come to the general

conclusion, that at any rate great "community" value has been obtained.

There are one or two specific points, the first being *Public Health* and *Hospitals*. Sir Gwilym has been limited in that he can give the figures for 1932-3 only; and when he next speaks on this subject before the Society, he will, I think, have a different situation to deal with, owing to the fact that local authorities—counties and county boroughs—are appropriating their hospitals for public health services as quickly as they possibly can, with the result that endeavours are being made so that the hospitals maintained by the local authorities shall be as "acute" as, shall we say, St. Thomas's. I am wondering if Sir Gwilym has considered whether that action by the local authorities, supported as it is by all public opinion, is likely in the near or distant future to affect the great voluntary hospitals of this country.

Poor Relief. There again, under this heading, Sir Gwilym has, of course, had to include all the institutional treatment, but in the future poor relief will in the main cover what we call to-day "out-relief," and when talking of "out-relief" to-day, we are not thinking of the able-bodied unemployed; they are dealt with, directly or indirectly, through the Unemployment Assistance Board.

Several of us during the last few months have been engaged in the preparation of our annual estimates, and I do not think it is putting it too high to say that we have been amazed at the increase in the cost of out-relief. We have looked for explanations, but without a great deal of research work it has been impossible—anyhow so far as I am concerned—to arrive at a satisfactory explanation. But it does so happen that the same problem exists in the North as in the South, and an interesting memorandum has recently been prepared by Mr. D. Caradog Jones on the relief of the poor. Talking about the ordinary poor, he says:—

"It is made up of pensioners who are past work; other aged, infirm or sick persons; widows, and wives separated from or deserted by their husbands. Their number can thus have no direct bearing upon the relief of the able-bodied unemployed; but it may have an indirect bearing. An elderly parent, for instance, living in a separate home, may be partly dependent upon a married son or daughter and may have to apply for relief if the son or son-in-law becomes unemployed. Many of the older generation will suffer considerable privation rather than ask for the first time for public assistance; but if they discover that they are treated not unkindly they will ask again with less hesitation. It is not surprising, therefore, if the young people, when they get back into work, fail to renew the help which they previously gave to their parents, and when earnings are small it is difficult to enforce any legal liability on the part of married sons for such maintenance."

Trading Services. Sir Gwilym says there is no clear division between trading and non-trading; for instance, provision for the dead—i.e. cemeteries—comes under trading, and provision for the living, under non-trading. But when we talk of the municipal trading services, I think we really have in mind electricity, gas,

transport, and perhaps water. I say "perhaps water," because in my opinion water is more of a health service than a trading service. But in the services I have mentioned, without a doubt, the community gets value for money, and that can be proved by the tables which are published in the technical papers.

Expenditure of Different Classes of Authorities. There are two points here, the first one being perhaps rather unimportant. Sir Gwilym says, "From the infants of the early days the County Councils have grown to great stature and girth." He assures me that he really does mean County Councils, and not County Officers.

The next point is, I think, rather interesting. He says that county boroughs have increased in number and area and counties have diminished in area; in other words, that the county boroughs have cast their eyes on the promised land and have gone into it and taken part of the counties. It is interesting now to see what is happening in one or two of the big cities in connection with the action taken by certain county boroughs. I have here a publication recently issued by the Manchester Corporation. I do not know whether a very great friend of ours, who is also a member of this Society, has been responsible from time to time for the extension of the City of Manchester, but if he has, I have no doubt that by now he has already got a reply to the observations which have been made by the Manchester City Council. This Report came about because there has been an endeavour in Manchester to stabilize the rate, and this is what it says:—

"To some extent the movement of the population from the centre of the City may be neutralized by the erection of flats in the future, but it appeared to your Sub-Committee that although that factor would have its influence, it would not materially mitigate the situation that has arisen and is certain to be accelerated in the next decade in relation to the municipally-provided services in the older parts of the City. It may be expected that schools, baths, libraries and other services will continue to attract less and less support in these areas, with their considerably decreased population. The Committees of the City Council have no alternative but to provide services for the population which has moved into the outer districts of the City, but this duplication of service is very costly, and unless it can be accompanied by some corresponding savings brought about by a restriction or contraction of expenditure on the services provided in the older parts of the City a continuing upward trend in the City's expenditure on these services is inevitable."

In other words, unless something is done in these county boroughs which have been extended, there is going to be waste.

On the question of areas, I would like to put a point to Sir Gwilym, because it is one that I have been considering for some time. I am wondering whether he thinks that the time will come when for certain services—Highways, Health, or Higher Education—the existing boundaries will go, to make way for a system of zoning.

I thank him for his analysis of debt; he truly states that the figures are not good for the alarmist, but when one talks about debt one often has in mind the cost to the local authorities of raising

the necessary capital, and there is a school of thought in this country which favours the idea of a national loan pool, somewhat on the lines of the Public Works Loan Board, where all authorities should obtain the capital they require at the same rate of interest. I wonder whether Sir Gwilym would be kind enough to give us an expression of his opinion on this.

Capital Expenditure out of Revenue. It will probably surprise many of the Society that the old argument of money fructifying in the pockets of the ratepayers still has very much force. I have recently had to contend with it. My county decided only a year ago that the product of a 2*d.* rate should be set aside for capital expenditure out of revenue. Being faced next year with increased expenditure on out-relief and social services in general, instead of reducing expenditure they have decided to reduce that 2*d.* by 1*d.*

Just a point in connection with Pension Funds. It is common knowledge that local authorities have the necessary statutory power to utilize the monies of these funds for new capital works. I would like to ask Sir Gwilym whether in his opinion it would not be advisable, as these funds must be regarded as trust funds, for some limitation to be placed on that utilization?

Sir Gwilym's observations on grants are particularly helpful at the present time. I should dearly love to ask him one or two questions in connection with this matter, but considering that the block grant is now under review, I think perhaps it would be rather unfair.

I thanked the President in my opening remarks for giving me this opportunity on behalf of my colleagues in the municipal services, and the Institute of Municipal Treasurers and Accountants, to offer a tribute to a well-known public servant. Without any sense of flattery, Mr. President, I do that with the greatest pleasure, and I now submit to you a very hearty and sincere vote of thanks to Sir Gwilym for this wonderful review which he has been good enough to prepare for us.

SIR JOSIAH STAMP: Sir Gwilym Gibbon very engagingly endeavoured to entice me from my way by reference to a dual personality, but I decline the invitation; my right hand does not know what my left hand does, and I personally do not know what either of them is up to!

I would like to congratulate the proposer of this vote upon the extent to which, having regard to what he had said about having no ammunition, he was able to give a sustained bombardment. My own line of approach will be a little different, but none the less enthusiastic for the proposal that I am seconding.

This paper is not only of very great importance, but also extraordinarily timely. We have just been celebrating the centenary of the Municipal Corporation Act of 1835, and in various ways that very important section, whether judged by population or expenditure, or however you look at them, the municipal corporations of this country, have been celebrating their growth, and in 1935 one particular feature of their arrangements was a very important

volume on Municipal Life over a hundred years. It fell to my lot to write the section relating to Finance in that volume, and in going back to 1835 and considering municipal finance of that time, I found it very difficult to get any firm ground upon which to base comparative facts; there were plenty of Blue Books, containing vast masses of statistics, but nothing that could be brought into comparable relation with to-day, until I turned to the annals of the Statistical Society, and there I found in the earliest volume in the library a short paper, the forerunner of this evening's paper, in which appeared something on which I really could proceed.

Sir Gwilym's survey goes back fifty years. There is much greater resemblance between the present and 1884 than between the present and 1834—the kind of resemblance one would expect to find between a boy and a man. Most of us when we are presented with the photographs of ourselves or others as boys or young men may express disappointment at the development, but we can nevertheless see that one is actually the forerunner of the other; but when you are presented with the photograph of the infant babe that you are told is yourself or your friend, it takes a fond mother or complacent friend to allege that they can see that one really is the same as the other.

That is the kind of scale upon which this comparison takes place, because in those remote days it is difficult to find the *kind* of comparability that exists now in the last fifty years between figures which, however imperfect in 1884, were at any rate on similar lines and related to similar things. My own task was more difficult because I had to try to segregate municipal finance from the rest, but it was easier because I had not to hunt through for figures of various services which did not then exist. But the problems of comparability were great, and had to be overcome in ways not quite the same, and yet somewhat similar. The problem of comparability of areas was very great because even taking the municipal areas as a description, they have not only altered in area, but also in content, and the difference of population alone made comparison invalid. Many places we have never heard of to-day were included, and vice versa; one got over that to a great extent by testing or sampling in various ways, and by taking figures per head. For instance, since 1840 in some boroughs there has been a rise in rates from 2s. to £4 per head, which is very comparable with the figures Sir Gwilym has given for the whole country in recent years.

The difficulty about prices can be got over in another way than that of the price index, if you have available a fair estimate of the income per head, assuming that the effect of the price level on the amount spent in local government is pretty much the same as the effect upon incomes in general, and so by taking the amount spent, or raised, as the case may be, per head per pound of income, you get a comparable ratio without resort to a price-level index.

For that period there was no great change in the slope of income distribution but the average rate increased, so that municipal rates per pound of income per head increased about $8\frac{1}{2}$ times, and the

balance of rates increased over ten times. This indicates the immense difference of the scale of municipal services and the demand for them, and the difference will not be very much altered when you bring in the whole of the country.

The great value of this paper is not merely in the number of figures given for past years, but in providing a line for future comparison. I can foresee that in this Society fifty to one hundred years hence this will be a valuable basis for comparison.

I adopted a second method to overcome differences in aggregate, viz. to take a smaller number of identical boroughs—say seven—and to aggregate their figures to cancel out their individual peculiarities. The third method was to take the individual borough, and I did that in two random typical cases, and went to the archives of the boroughs themselves, taking actual figures for 1834 and 1835, and putting them side by side with those for 1934 and 1935, comparing them item by item. These are three methods by which comparisons may be made and some of the difficulties got over.

The future will hold fewer terrors than the past with regard to reliance upon rateable values. When rates are given as so much in the pound, you must multiply that by the additional stringency of estimates for to-day.

A new reaction is setting in in depressed districts with very heavy rates. We are accustomed to regard the rateable value as a thing standing absolute; but if the rate in the pound becomes heavy enough, a point is reached where it has an inverse effect upon the rent, and so reduces the rateable value and again increases the rate in the pound, with no visible point of equilibrium. That must be borne in mind in the future.

The idea of what constitutes a municipal trading service varies, although it is being stereotyped to-day. In the early accounts I found that scavenging was a trading service; people who did it made an income from the products obtained! Fire services were covered by personal subscription from house to house, with a kind of co-operative fire brigade; only gradually did that emerge into a fully fledged municipal service.

We shall never be able to tell exactly whether the surplus of municipal trading is comparable with a trading profit made by a commercial concern. It is nearly possible in the case of electricity and gas, but in many cases it is very difficult. These comparisons of municipal profits with commercial profits require great care.

I would like, in conclusion, to repeat that this is not only a timely paper, but an extraordinarily important one, and when we consider its new classifications and comparisons by decades and collection of figures that cannot be got in any other way, it will be realized that Sir Gwilym has conferred not only upon the Society, but also upon the whole country, a very great service.

MR. B. S. TOWNROE said that he felt so overawed in the presence of Sir Josiah Stamp and other famous statisticians that it was quite impossible for him to say anything worthy of such an important paper. But as one who had sat at the feet of Sir Gwilym and who

had dared to enter the portals to which reference had been made, and not been thrown out immediately, and, further, as one who was engaged in local government work, he thought the paper was of very real value. He was hoping to study it carefully, and to pass it on to his Borough Treasurer.

He rather regretted that Sir Gwilym had not engaged in some of that machine-gun fire of wit and humour to which those who had served under him were accustomed. At the same time, he realized that in a matter like this he was thinking not only of the present generation, which owed him a great debt, but also of future generations who would find the paper to be a mine of information. He added his tribute of thanks to Sir Gwilym for his excellent paper.

MR. LEAK said that when he saw the title of the paper he was encouraged to hope for an answer to a problem which had interested him for a length of time, viz., the precise effect of the De-rating Act upon industry. Sir Gwilym, in the course of his summary of his paper, had given one figure bearing on this subject. That figure did not appear to be in the paper; it was that there was a decline of forty millions in assessable value as the result of the De-rating Act. That Act covered industry, transport and agriculture. Mr. Leak was primarily interested in industry, and wondered whether it would be possible to have some information as to the precise effect upon industry. He had looked at some of the Ministry of Health reports without very much enlightenment, and he had not been able to find an exact assessment of that position. He had hoped it might have been included in the paper and that Sir Gwilym would have thrown some light upon what industry had paid in rates before, and by how much they were relieved by the Act. Perhaps Sir Gwilym in his reply might be able to give that information.

MR. SLATOR thought he could send some figures to Mr. Leak which would give him a good deal of the information he required.

MR. CONNOR wished to join in congratulating Sir Gwilym upon his excellent paper. The task of delving out this information and displaying it to the Society in an intelligible form had been immense, and it would be difficult to find anyone better qualified to have undertaken it.

In an enquiry into local government finance there were two main difficulties to be faced. The first was connected with the raw material and the second with tests of progress. The raw material in this case consisted of summaries of audited accounts, and these accounts were framed upon a financial and not a costing basis. Their main function was to show that expenditure had been properly authorized and to provide bases for the distribution of Government grants. For this purpose it was necessary to set up a rather complicated accounting system, and the results as a whole were not designed to bring out in the best possible fashion the distribution of Local Government activities between the various services; in

fact, anyone who had anything to do with local government finance would realize that the allocation of expenditure to services was often a matter of speculation. The question therefore whether expenditure had been efficiently and economically applied was more or less a side-issue.

The second difficulty was that in a commercial undertaking there were definite tests, depending upon the prices charged for goods and services by other concerns. Then there was the test provided by the rate of return on invested capital. These tests acted internally as well as externally, in the sense that when a charge was made by one department for another's services, the charge could be checked up on a commercial basis. As far as local government services went, in the majority of cases there was no question of any market value, and the tests were not forthcoming. Therefore, although it might be supposed that the Ministry's figures reflected in a broad fashion the general trend of expenditure, they could hardly be used for any form of refined comparison.

Everyone must have been struck by the stupendous increases in expenditure during the last fifty years, and these increases were much larger than usually supposed. Complaints on this score were rife, and those who made most noise were generally people who were most responsible. About half local government business consisted of constructive work, and the other half of clearing up the muddle and disorder created by our unregulated habits. The local government authority was the recipient of every waste product and object which had survived its usefulness.

Mr. Connor wished that Sir Gwilym had said more upon the extremely interesting subject of the grants under the 1929 Act; he could not imagine anyone more competent to disentangle this question, and he hoped that in due course Sir Gwilym would be able to offer the Society another paper.

Finally, if he dared, he would like to ask one question: What became of the draft report of the Meston Committee?

Dr. ISSERLIS said he would be grateful if he might have an answer to one question which puzzled him. Sir Gwilym had explained that he had found it convenient to include a couple of port Authorities, the Mersey Docks and Harbour Board and the Port of London Authority, and the Metropolitan Water Board, in the tables. It would be interesting to know, for the purpose of future comparisons, what Port Authorities were referred to in the table on p. 474, under the heading of "Harbour Authorities." The Port of London Authority's statistics started in 1909, and Dr. Isserlis took it that the Mersey Docks and Harbour Board was included in the earlier figures.

Mr. INFIELD said he had had no intention of speaking that evening, but he could not help getting up and adding a few words of tribute to his erstwhile chief, Sir Gwilym, for his interesting paper. The paper had been most intriguing, and raised a number of questions in one's mind, so that one wished that he had pursued some of his

points further and had been a little more inclined to draw speculative inferences; perhaps he would take the opportunity of a subsequent paper to develop the points which he had raised.

Sir Gwilym finished his remarks on a warning statement about the growth of the percentage of local expenditure which was being borne by grants, and inferred that if this process continued, the sense of responsibility of local authorities would be undermined, and a long farewell could be said to democracy in this country. It was true that the proportion of grants to the total of rates and grants had gone up from 35 to 45 per cent. in the last ten years, but Sir Gwilym himself had said that in Huntingdon the percentage was as much as 77, and that in a good many counties it was more than 60. Surely if the sense of local responsibility had not suffered in those counties, one might argue that the average for the country as a whole might go up well beyond 45 per cent. before a danger point was reached.

Another point was that if a kind of comparative method, such as was referred to by Sir Josiah Stamp, could be applied to the subject-matter of Sir Gwilym's paper. For instance, if one took rate expenditure per head of population and compared it year by year over a period of, say 10 to 20 years with the index of production on the one hand and the rateable value per head on the other, one would get some startling results. Mr. Infield had, in point of fact, himself made an attempt to do this. The data available were unfortunately very limited, but they were sufficient to enable one to make a comparison, and from this comparison one drew the inference—a rough conclusion, which, however, was only a conclusion which might be knocked on the head by more detailed examination—which bore out what Mr. Rattenbury suspected: local government expenditure was increasing, but so was the wealth of the country as measured by rateable per head, and also the standard of living of the people as measured by the index of production, and the comparison which Mr. Infield had attempted led him to the view that local government expenditure was not increasing at a faster rate than were the wealth and standard of living of the country. Perhaps Sir Gwilym would work up this subject and confirm or disprove this comforting conclusion; his efforts would be sure to result in a paper as interesting as the one which had been discussed that evening.

Mr. Infield thanked Sir Gwilym for the encouragement he had given.

MR. MACROSTY said there was one point in Sir Gwilym's paper which impressed him very much, and that was that local government had altered its character since 1835. Even well into the middle of the nineteenth century local authorities did deal with affairs which were specifically local, but to-day they dealt with the local administration of affairs of national importance. That, of course, one saw at once when one reflected upon the problems presented by the "special areas," whose state of depression had mainly arisen not out of local causes, but out of national causes. That had brought to the front in an acute degree the fact that in dealing with large categories of local affairs it was impossible to rely upon

local resources. It was necessary to depend to a large extent on contributions from the central government, and that again raised another problem of how to secure economy of administration and at the same time to utilize fully local knowledge of local circumstances.

Mr. Rattenbury threw out a hint that in regard to some services a system of zoning might be necessary. Mr. Macrosty certainly thought that with regard to many services the local government unit would have to be extended much beyond its present limits. It was known that on Tyneside a good deal of the trouble arose from the fact that so many local authorities were at work in the area. Perhaps for some services we might have "to restore the Heptarchy." Those who were only accustomed to local government as it was to-day, and who could not recall what it was some 40 or 50 years ago, when the typical local authority was a small body, very often dealing only with a particular branch of administration—such as a school board—might find it difficult to realize the change that had taken place, and it might be useful to remind them that then it was often difficult to get good administration when extremely small bodies were dealing with limited subjects.

PROFESSOR GREENWOOD said that the time had arrived for him to put the vote to the meeting. He was sure everyone had listened to Sir Gwilym's paper with great interest. Even a mere non-financial person like himself had listened to it with great interest. It seemed to him that in Sir Gwilym there was a curious mixture of Celtic melancholy and a sort of optimism. For example, early in his paper Sir Gwilym expressed doubts as to whether a return were being received for the expenditure on education, and he thought that might be enquired into—but not by experts. Professor Greenwood's trouble about it was that he did not know how to define and statistically measure a return for education, and he had never been able to discover what an "educational expert" was. Apparently university or school teachers were not educational experts, but interested parties. The only person he had met whom he had heard *described* as an educational expert was a gentleman whose claim was based on the fact that he had sat for many years on the Education Committee of a large local authority. What such educational experts added to the sum of knowledge on education he did not know. When Sir Gwilym passed from education to medicine, melancholy passed into optimism; here, it seemed, objective tests could be applied. In the sense that, after the introduction of what all men and women of goodwill regarded as sanitary reforms, rates of mortality and morbidity had declined, that was certainly true. But the difficulty of isolating causation in a nexus of correlation remained.

He (Professor Greenwood) wondered whether there were not a good deal of nonsense in the demand for objective tests of this and that. More than 70 years ago Simon caused a report on the facilities for treating patients suffering from infectious fevers to be prepared by two eminent clinicians. The findings led to the development of the system of public institutions for the reception of patients suffer-

ing from infectious diseases, which in the aggregate had involved the expenditure of millions of public money. Much was said then, and had been said since, of the advantage such a system would have in preventing the spread of infection, and there was little doubt that a good deal of what was said under this heading was incorrect. But a far stronger motive was a desire to see that sick people should receive decent human care. That desire had been amply satisfied; even if it could be shown—as of course it could not—that the hospitalization of infectious diseases had never saved one life nor prevented the development of one fresh case, the expense could be justified not by objective tests, but by a satisfaction of the sense of common human kindness.

He had great pleasure in putting to the meeting that a hearty vote of thanks be accorded to the reader of the paper.

SIR GWILYM GIBBON, in reply, said: I am much obliged to the mover and seconder of the resolution and to the other members of the audience for this vote of thanks. The time-honoured practice of the Society of leaving the answer to the discussion and questions for a later *Journal* is so handy that I should be the last who would think for one moment of infringing upon it, even though I am sorely tempted to do so by the heresies of two of the leading members of the Society on objective tests.

The kind things that have been said have been much too kind, and I am almost sorry that I have not been asked to criticize my own paper.

Sir Gwilym subsequently wrote as follows:—

To reply adequately to some of the questions which have been raised would require more space than is at my disposal. I will deal first with two large questions of principle.

Some speakers referred to my comments on objective tests, notably the President and Mr. Rattenbury. It is, of course, true that reforms are often introduced from impulses of a general order, sometimes barely conscious. But that is all the more reason for ascertaining as accurately as possible the results obtained. Human nature and human society are complicated affairs, and measures generally produce results by no means intended or foreseen. Objective tests are only an attempt at more accurate ascertainment, just as are costing returns in business—and costing returns have met with as much scepticism as now encountered by objective tests of results. Admittedly the latter are by no means easy to obtain in social affairs, but some are now available and are used, and more could be discovered with sustained research. Every thoughtful administrator of experience knows well how misleading general impressions can be. Without adequate tests our journey through social reform is made in a mist of blind faith.

The second question, raised by Mr. Rattenbury and Mr. Macrosty, is that of the need of larger local areas for certain services. It is quite possible that still more services may be taken over by the state; for instance, there is some demand that at least the principal arterial roads should be so transferred. There are a number of

present local services which under modern conditions need to be considered from a broader standpoint than that of any one local government unit, and at any rate the main lines of policy determined on the wider basis. Looking at some service in isolation, transport or water supply or health institutions, for instance, an area adapted to the particular needs may seem the right solution. But that is to look at the problem in a mechanical way, and government is not a mere matter of mechanics, but of life. The danger is, if large areas and *ad hoc* administration are carried far, that civic spirit and the vitality of local government, even now by no means strong enough, may be undermined, with all the consequent mischief for a democratic community. But the pressure of conditions may force "mechanical" solutions unless local authorities show more readiness for the common handling of matters of common concern. At the same time, the inconveniences and waste from present shortcomings should not be exaggerated. Tyneside, for example, has been mentioned; the present multiplicity of Authorities has had little to do with the prolonged depression in that district (now becoming much ameliorated), though it is possible that some rearrangement of areas might facilitate remedial measures.

Dealing now with some of the other questions raised, and taking each speaker in turn :—

Mr. Rattenbury—I agree that it appears probable that the relative place of the voluntary hospital will grow steadily less and that of the public more, with some "pretty" problems of finance. For the good of the country, it is to be hoped that the process will be gradual, and that definite efforts will be directed to that end.

It seems to me that more readiness to seek and to give public assistance is inherent in modern conditions. Still higher standards of administration are therefore required, and it is urgently necessary that they be forthcoming.

The general tendency in large towns has been towards migration to the outer suburbs. New public services have to be provided for the latter, without corresponding reduction elsewhere. Whether these services can most advantageously be provided by the Town Council or by other Authorities can be decided only according to local conditions.

I see no general advantage, and I see disadvantages, if every authority were required to obtain their capital monies from a central pool. It seems to me that an Authority should not invest all the capital of its Pension Fund in its own securities.

Sir Josiah Stamp—I fully appreciate from personal experience the difficulties of comparing local expenditure in the 1830's and following decades with that of the 1930's. The field is full of pitfalls. Not only are the services very different, but in the earlier years there were many *ad hoc* authorities independent of the Town Council. The standards of assessment were also more capricious and there are other difficulties.

I suggest that the best comparison of municipal and commercial undertakings is provided by adequate cost returns, with due regard to services rendered.

Mr. Leak—Some figures on loss of rateable value from de-rating are given in the notes to Table VII of the appendix to my paper. It is estimated that the loss of rateable value in England and Wales from the de-rating of 1930 was—agricultural, £7.4m.; industrial, £20.9m.; freight transport, £8.2m.; total, £36.5m. The corresponding figures for Scotland are estimated at £2.1m., £3.3m., £1.4m. and £6.8m. respectively.

In considering the effect of de-rating in later years, account has to be taken of the increases or decreases of rateable values which would have taken place without de-rating, as from new hereditaments, the falling out of old ones and changes in standards of assessment. And in considering actual rate relief, account has to be taken not only of actual level of rates, but also of what would have been the level had de-rating and the other changes made as part of the one scheme not been effected.

Mr. Connor—Cost accounts are not within the subject of my paper. They are being increasingly kept by Local Authorities, though still more is needed. Allocation of cost to the several services, in particular overhead costs, is always a difficulty, but arises chiefly when one Authority is compared with another. It does not much affect the figures which I have given.

Dr. Isserlis—The published statistics of local expenditure include those for all dock and harbour bodies, whether Local Authorities in the ordinary sense or not, which levy tolls or dues under powers granted by Parliament, except railway, canal and joint-stock companies. The principal bodies of this kind included are the Port of London Authority, from 1909, and the Mersey Docks and Harbour Board, for the whole period with which I am dealing. There are many Joint Water Boards or Committees, composed entirely of representatives of Local Authorities.

Mr. Infield—There can be no question of the increase of wealth and of greater ability to bear the much heavier public charges. The question which I should have liked to explore is the extent to which this increase makes the present charges no less burdensome. Informed guesses can be made in various ways, but any conclusion can be but very provisional without reasonably firm estimates of income and its distribution. Any use of rateable values must, of course, take account of the changes in the level of assessment.

I have already referred to comments made by Mr. Macrosty and the President.

As a result of the ballot taken during the meeting the candidates named below were elected Fellows of the Society :—

Kenneth Bell Elbourne.

E. G. Chambers.

T. B. Dalal, B.A.

Desmond John Falkiner Morton.

S. H. Parikh, B.Com.

John Edwin Wadsworth.

WILLIAM STANLEY JEVONS

1835-1882

A CENTENARY ALLOCUTION ON HIS LIFE AND WORK AS ECONOMIST AND
STATISTICIAN.*

By J. M. KEYNES.

[Read before the ROYAL STATISTICAL SOCIETY, April 21st, 1936, the
PRESIDENT, PROFESSOR M. GREENWOOD, F.R.S., in the Chair.]

I.

STANLEY JEVONS was born in the year after Malthus's death. But he was only seven years senior to Marshall and ten years senior to Edgeworth. Professor Foxwell lectured in his stead at University College *before* Jevons took up his professorship there. He examined my father in the Moral Sciences Tripos of 1875, his name being known to me from my early years as, in my father's mind, the pattern of what an economist and logician should be. Thus, though we celebrate to-day (a little late) the centenary of his birth, though it is sixty years ago that Professor Foxwell lectured in his stead and more than fifty years since his death; nevertheless, Jevons belongs to the group of economists whose school of thought dominated the subject for the half-century after the death of Mill in 1873, who are the immediate teachers and predecessors of ourselves here assembled to pay our duty to his memory.

His family belonged to the class of educated nonconformists, who, without academic connections, made up, in the first half of the nineteenth century, the intelligentsia of Liverpool, Manchester, Leeds and Birmingham, and became the backbone of Bentham's foundation (in 1826) at University College, London, and of Owens College, Manchester (founded in 1846). The family, and many of their connections, were Unitarians; and in substance Stanley Jevons remained of that faith to the end of his life. His father was an iron merchant, a friend of Stephenson, much interested in the engineering innovations of the age, said to have constructed (in 1815) the first iron boat that sailed on sea-water, a supporter of the construction of the Thames Tunnel to his own financial loss, author of a small book on law and of an economic pamphlet. His mother, whose ninth child he was, herself a poetess, was the eldest of the gifted family of William

* I have, of course, drawn freely on the main source for Jevons's life—his *Letters and Journal* edited by his wife. I am also much indebted for information to his son, H. S. Jevons, who is a member of our Council to-day.



WILLIAM STANLEY JEVONS

[To face p. 516]

Roscoe, the solicitor and banker of Liverpool, collector and dilettante, but also a learned historian, author of the *Life of Lorenzo de Medici* and the *Life and Pontificate of Leo X* amongst much else (including the children's classic *The Butterfly's Ball and the Grasshopper's Feast* *). Stanley Jevons himself married a daughter of J. E. Taylor, the founder of the *Manchester Guardian*, and was a connection by marriage of R. H. Hutton of the *Spectator*.

His father and his grandfather Roscoe, though both unusually gifted and of unquestioned probity, were both of them bankrupted, the former in the financial crisis of 1848 and the latter through a run on his bank in 1816; so that he had good hereditary cause not to overlook the phenomenon of business fluctuations. Stanley Jevons took much interest in his own investments and financial position, which he managed, if certain hints in his correspondence are to be trusted, with close regard to his theories concerning the Trade Cycle and the gradual exhaustion of our reserves of coal. His own capital was small, but his wife had some means of her own, and Jevons, I am told, augmented their income by good investment of their savings. He was an example of a man who at every critical stage of his affairs sacrificed his income relentlessly in order to secure his major purposes in life, but was far, nevertheless, from despising money, and suffered severe pangs each time that a sacrifice was called for. In many, perhaps in most, respects he was a good Victorian, averse both intellectually and morally to the outlook of the extreme Left, appreciative alike of a Conservative Party "desirous at all costs"—I quote his own words—"to secure the continued and exclusive prosperity of this country as a main bulwark of the general good," and, on the other hand, of a Liberal Party "less cautious, more trustful in abstract principles and the unfettered tendencies of nature." †

The circle in which Stanley Jevons grew up was interested in social and economic problems. His grandfather, William Roscoe, was an ardent social reformer, active over the abolition of the slave trade. His father wrote a pamphlet entitled *The Prosperity of the Landlords not Dependent on the Corn Laws*. It is recorded that his mother read with him Archbishop Whateley's *Easy Lessons on Money Matters*. His headmaster, Dr. Hodgson, at the Mechanics' Institute High School in Liverpool, where he first went to school,

* "With Step so majestic the *Snail* did advance,
And promis'd the Gazers a Minuet to dance.
But they all laugh'd so loud that he pulled in his Head,
And went in his own little Chamber to bed."

Written to amuse his own children, it was published in 1807, sold 40,000 copies in the first year and was popular for at least three-quarters of a century after that.

† *The Coal Question*, p. xviii.

was afterwards Professor of Political Economy at Edinburgh. Nevertheless, Jevons was educated, not in the moral sciences, but in mathematics and in biology, chemistry and metallurgy.* In 1852, seven years before the publication of Darwin's *Origin of Species*, when he was seventeen years old he wrote in his journal:—

I have had several rather learned discussions with Harry about moral philosophy, from which it appears that I am decidedly a "dependent moralist," not believing that we have any "moral sense" altogether separate and of a different kind from our animal feelings. I have also had a talk about the origin of species, or the manner in which the innumerable races of animals have been produced. I, as far as I can understand at present, firmly believe that all animals have been transformed out of one primitive form by the continued influence, for thousands and perhaps millions of years, of climate, geography, etc. Lyell makes great fun of Lamarck's, that is; of this theory, but appears to me not to give any good reason against it.†

When he was eighteen the financial difficulties of his family led to his accepting an appointment as an assayer at the Sydney Mint, lately opened as a result of the Australian gold discoveries. In this post he remained for nearly five years. To his ambitions it was a great disappointment to leave University College half-way through his studies, and his main object in leaving Australia was to return there to complete his course for the M.A. degree. But his long period of solitary thought and slow gestation in Australia, at an age when the powers of pure originality are at their highest, had been abundantly fruitful. For soon after his return, the outlines of his principal contributions to knowledge were firmly fixed in his mind. The last third of Jevons's life after he was thirty was mainly devoted to the elucidation and amplification of what in essence he had already discovered.

The results of his solitary thinking in Australia and afterwards, which were produced in a series of studies covering a little more than the decade following his return to England at the end of 1859, fall into two distinct groups, both foreshadowed by his communications to the Cambridge meeting of the British Association in 1862—the first concerned with his inductive studies of fluctuations, and the second with his deductive contributions to pure theory. But before considering these in detail, it will be convenient to mention *The Coal Question*, his first book and the first occasion of his coming prominently before the public.

* The influence of his scientific training on his approach to economics, statistics and logic was recognized by his election (in 1872) as a Fellow of the Royal Society—the first economist so elected, I think, since Sir William Petty, and followed only by Giffen and Palgrave.

† *Letters and Journal*, p. 23.

II.

The Coal Question ; an Inquiry concerning the Progress of the Nation and the Probable Exhaustion of our Coal Mines is by no means one of Jevons's best works. It is most brilliantly and engagingly written, with nothing omitted which could add to its attractiveness and the effect of its impact. But its prophecies have not been fulfilled, the arguments on which they were based are unsound, and re-read to-day it appears over-strained and exaggerated.

It was Jevons's thesis in this book that the maintenance of Great Britain's prosperity and industrial leadership required a continuous growth of her heavy industries on a scale which would mean a demand for coal increasing in a geometrical progression. Jevons advanced this principle as an extension of Malthus's law of population, and he designated it the *Natural Law of Social Growth*. In the form in which he enunciated the principle—namely, "that living beings of the same nature and in the same circumstances multiply in the same geometrical ratio"—it is, as he said, "self-evident when the meanings of the words are understood." * Yet in spite of his warning that "even if we do not change in inward character, yet our exterior circumstances are usually changing," Jevons's extension of the truism can easily mislead. For he continues :—

Now what is true of the mere number of the people is true of other elements of their condition. If our parents made a definite social advance, then, unless we are unworthy of our parents, or in different circumstances, we should make a similar advance. If our parents doubled their income, or doubled the use of iron, or the agricultural produce of the country, then so ought we, unless we are either changed in character or circumstances.†

From this it is a short step to put *coal* into the position occupied in Malthus's theory by *corn* :—

Our subsistence no longer depends upon our produce of corn. The momentous repeal of the Corn Laws throws us from corn upon coal. It marks, at any rate, the epoch when coal was finally recognized as the staple product of the country; it marks the ascendancy of the manufacturing interest, which is only another name for the development of the use of coal.‡

It is easy to see what alarming deductions from this could be made convincing to a generation which accepted without question a crude version of Malthus. For, as Jevons pointed out, "the quantity of coal consumed is really a quantity of two dimensions,

* *The Coal Question*, p. 149.

† *Op. cit.*, p. 149.

‡ *Op. cit.*, p. 150.

the number of the people, and the average quantity used by each. In round numbers, the population has about doubled since the beginning of the century, but the consumption of coal has increased eightfold and more. Again, the quantity consumed by each individual is a composite quantity, increased either by multiplying the scale of former applications of coal, or finding wholly new applications. We cannot, indeed, always be doubling the length of our railways, the magnitude of our ships, and bridges, and factories. But the new applications of coal are of an unlimited character." * *

By this time the reader has been carried away from the carefully qualified truisms with which he began, and Jevons concludes in splendid and exciting terms :—

We are growing rich and numerous upon a source of wealth of which the fertility does not yet apparently decrease with our demands upon it. Hence the uniform and extraordinary rate of growth which this country presents. We are like settlers spreading in a new country of which the boundaries are yet unknown and unfelt.

But then I must point out the painful fact that such a rate of growth will before long render our consumption of coal comparable with the total supply. In the increasing depth and difficulty of coal mining we shall meet that vague, but inevitable boundary that will stop our progress. We shall begin as it were to see the further shore of our Black Indies. The wave of population will break upon that shore, and roll back upon itself. And as settlers, unable to choose in the fair inland new and virgin soil of unexceeded fertility, will fall back upon that which is next best, and will advance their tillage up the mountain side, so we, unable to discover new coal-fields as shallow as before, must deepen our mines with pain and cost.

There is, too, this most serious difference to be noted. A farm, however far pushed, will under proper cultivation continue to yield for ever a constant crop. But in a mine there is no reproduction and the produce once pushed to the utmost will soon begin to fail and sink to zero.

So far, then, as our wealth and progress depend upon the superior command of coal, we must not only stop—we must go back.†

Jevons, it must be confessed, meant the book to be *épatant*. For it is not, I think, unfair to attribute the striking manner in which it is written to his extreme anxiety that his ideas should not be overlooked. His highly original communications to the British Association (in 1862) had fallen flat. His diagrams for business forecasting (also in 1862), the precursor, sixty years too soon, of so many half-baked loaves, had been published at his own expense and, barely mentioned in *The Times* and the *Economist*, lost him money. His pamphlet on Gold ‡ (in 1863), though it attracted attention a little

* *Op. cit.*, pp. 150, 151, slightly abridged.

† *Op. cit.*, p. 154.

‡ *A Serious Fall in the Value of Gold ascertained, and its Social effects set forth, with two Diagrams.*

later on,* had sold 74 copies.† Yet he had a passionate sense of vocation and of having something valuable to give the world. On April 25, 1863, he wrote in his Journal:—

Now, I suppose I am low because my essay on "Gold" is out, and as yet no one has said a word in its favour except my sister, who of course does it as a sister. What if all I do or can do were to be received so? In the first place, one might be led to doubt whether all one's convictions concerning oneself were not mere delusions. Secondly, one might at last learn that even the best productions may never be caught by the breath of popular approval and praise. It would take infinite time and space to write all I have thought about my position lately. As I have even thought myself in many ways a fool, I am in no way surprised to find that many notions which I have had are ridiculous. At last I fairly allow that the one great way of getting on in this world is to get friends, and impress them with a notion of your cleverness. Send them about to advertise your cleverness, get their testimonials like so many levers to force yourself where you wish to go. How well did Shakespeare see through all these things when he wrote his sixty-sixth sonnet.

It is quite obvious to me that it is useless to go on printing works which cost great labour, much money, and are scarcely noticed by any soul. I must begin life again, and by another way, ingratiating myself where and when I can: only after long years of slow progress can one's notions be brought out with any chance of being even examined by those capable of judging of them.

Faulty as I am in so many ways, I yet feel that my inmost motives are hardly selfish. I believe they grow by degrees less so. Sometimes I even feel that I should not care for reputation, wealth, comfort, or even life itself, if I could feel that all my efforts were not without their use. Could I do it all anonymously I perhaps might consent to it. And yet the condemnation of friends and all you meet is hard to be borne, and their praise or admiration must be sweet. . . . I must go upon a different tack.‡

This time, therefore, he was determined that the public should listen to him. All the arts of showmanship are exercised to recall Political Economy from Saturn. It took Mr. Alexander Macmillan but a few days to perceive that he had been sent a best-seller.§ Within a year success was complete. He wrote in his Journal:—

* Fawcett quoted it in an address to the British Association, and Cairnes wrote to *The Times* about it. Jevons records that the *Economist* (*semper idem*) "has been induced to notice the subject in a cautious manner, and, though attributing to me some exaggeration of the matter, comes over to my conclusion substantially." *Letters and Journal*, p. 191.

† "I have just received the bill for my pamphlet on Gold, the total cost of printing, advertising, etc., is £43, and the offset by sales only £10; only seventy-four copies seem to have been sold as yet, which is a singularly small number." (Letter of July 24, 1863, *Letters and Journal*, p. 188.)

‡ *Letters and Journal*, p. 181.

§ *The Coal Question* was published (as were nearly all his subsequent books) by Macmillan, whose treatment of the young and unknown author should serve as a model of promptness to all succeeding generations of publishers. Jevons's entry in his note-book is as follows: "First attention given to the subject in 1861 or 1862. Inquiry commenced in January 1864. Chiefly carried out at Museum Library, June and July 1864. Writing completed before Christmas. Transmitted to Mr. Macmillan about 28th December. Accepted 6th January, 1865. Published during the week 24th and 30th April, 1865." *Letters and Journal*, p. 203.

Sunday Evening, 3rd December, 1865.—The work of the thinker and inventor may indeed prove for ever futile and mistaken; but even if it be in the true and successful path, it is not, and perhaps can hardly be, recognized at once. At least it is not. One of my chief reasons, for the little love of society, is that in most company my hopes and feelings seem snuffed out.

14th December, 1865.—Yesterday I had a letter from Sir John Herschel, approving in the most complete manner of my *Coal Question*, which I lately had sent to him. Long periods of labour and depression have to be repaid in brief moments of such satisfaction as that letter gave me—perhaps I may say amply repaid. If the book, which was to me a work of intense interest and feeling, is read by few and understood by fewer, it has at least the endorsement of one scientific man whom I should perhaps of all in the world select as the most competent judge of the subject as a whole.*

The shrewd publisher sent a copy to Mr. Gladstone, who replied, "I think it is a masterly review of a vast, indeed a boundless subject,"† and invited the author to call upon him. "My visit to Gladstone, however, was the striking event, which I shall not easily forget—as an author to meet a great minister in the height of his power."‡ Mill drew attention to the book in Parliament in a speech "in which he urged, for the sake of posterity, the present duty of making greater efforts for the reduction of the National Debt."§ Indeed, the book came opportunely as political ammunition in the controversy over the Sinking Fund. Jevons had written:—

A multiplying population, with a constant void for it to fill; a growing revenue, with lessened taxation; accumulating capital, with rising profits and interest. *This is a union of happy conditions which hardly any country has before enjoyed, and which no country can long expect to enjoy.*||

Thus it was easy to invoke the proposition that we were living on our natural capital, as a reason why the times were suitable for the rapid reduction of the dead-weight debt. Yet a little reflection might have shown that, if our demand for coal was going to increase indefinitely in a geometrical ratio, our future national income would be so much greater than our present income that the dead-weight debt would become of little account. Indeed, there is not much in Jevons's scare which can survive cool criticism. His conclusions were influenced, I suspect, by a psychological trait, unusually strong in him, which many other people share, a certain hoarding instinct, a readiness to be alarmed and excited by the idea of the exhaustion of resources. Mr. H. S. Jevons has communicated to me an amusing illustration of this. Jevons held similar ideas as to the approaching scarcity of paper as a result of the vastness of the demand in relation to the supplies of suitable material (and here

* *Loc. cit.*, p. 215.

† *Loc. cit.*, p. 226.

‡ *The Coal Question*, p. 179.

† *Loc. cit.*, p. 219.

§ *Loc. cit.*, p. 222.

again he omitted to make adequate allowance for the progress of technical methods). Moreover, he acted on his fears and laid in such large stores not only of writing-paper, but also of thin brown packing paper, that even to-day, more than fifty years after his death, his children have not used up the stock he left behind him of the latter; though his purchases seem to have been more in the nature of a speculation than for his personal use, since his own notes were mostly written on the backs of old envelopes and odd scraps of paper, of which the proper place was the waste-paper basket.*

III.

We must now turn back to Jevons's long series of inductive studies of commercial fluctuations and of prices which began with his paper "On the Study of Periodic Commercial Fluctuations, with Five Diagrams" read before the British Association in 1862.† This brief paper of less than a dozen pages marks the beginning of a new stage in economic science. Others before Jevons had noticed seasonal changes and the alternations of good and bad business. He was not the first to plot economic statistics in diagrams; some of his diagrams bear, indeed, a close resemblance to Playfair's, with whose work he seems to have been acquainted.‡ But Jevons compiled and arranged economic statistics for a new purpose and pondered them in a new way. The significance of his method may be expressed by saying that he approached the complex economic facts of the real world, both literally and metaphorically, as a meteorologist. Most of his previous papers were in fact concerned with meteorology,§ and he begins his association with economics by the declaration:—

It seems necessary, then, that all commercial fluctuations should be investigated according to the same scientific methods with which we are familiar in other complicated sciences, such especially as meteorology and terrestrial magnetism."||

* Prof. Gregory has lately recorded the similar propensity of Edwin Cannan.

† Reprinted in *Investigations in Currency and Finance*.

‡ The *Charts of Trade*, mentioned by Jevons in the passage quoted in the footnote to p. 526 below, was doubtless Playfair's *Commercial and Political Atlas*, published in 1786.

§ He had published in Waugh's *Australian Almanac* for 1859, "Some Data concerning the Climate of Australia and New Zealand," a paper over fifty pages in length, which is best described by his closing words: "My object has been to present in an available form such accurate numerical data as are attainable, and secondly, to group together general information as to the winds, rains, rivers, floods, the geographical features of the country, and the meteorological circumstances of this part of the globe, so as to show what remarkable problems have to be solved, and what interesting connections of cause and effect may ultimately be traced and proved." (*Letters and Journal*, p. 112.)

|| *Op. cit.*, p. 4.

As we shall see subsequently, Jevons was equally at home in the simplified abstractions of pure theory. But this did not blind him to the fact that the material to be handled is shifting and complicated, and will only yield up its answer if it is arranged, compared and analysed for the discovery of uniformities and tendencies. Jevons was the first theoretical economist to survey his material with the prying eyes and fertile, controlled imagination of the natural scientist. He would spend hours arranging his charts, plotting them, sifting them, tinting them neatly with delicate pale colours like the slides of the anatomist, and all the time poring over them and brooding over them to discover their secret. It is remarkable, looking back, how few followers and imitators he had in the black arts of inductive economics in the fifty years after 1862. But to-day he can certainly claim an unnumbered progeny, though the scientific flair which can safely read the shifting sands of economic statistics is no commoner than it was.

In the first instance Jevons was primarily interested in the discovery and elimination of *seasonal* fluctuations. Indeed, the title of his early paper before the British Association is misleading if it suggests that it was concerned with the trade cycle. He points out that, although there had always been an unwritten knowledge of seasonal fluctuations in the minds of business men, he was only aware of two scientific studies of such matters—Gilbart on the bank-note circulation, and Babbage on the Clearing House statistics, published in the *Statistical Journal* for 1854 and 1856 respectively; and he then proceeds to study the seasonal movements of the rate of discount, of bankruptcies, of the price of Consols and of the price of wheat. He is not yet concerned with the larger swings, and his meteorological interests have not yet led him to sunspots. Nevertheless, his study of the monthly prices of many articles since 1811 put an idea into his head. "I was so much struck with the enormous and almost general rise of prices about the year 1853, that I was led to suspect an alteration of the standard of value." * As a result, in the next year (1863) his pamphlet on *A Serious Fall in the Value of Gold* leads him, not to cyclical, but to secular movements.

The state of the subject, when this unknown young man spent his savings on printing his notions about it, was extraordinarily backward. The Californian and Australian gold discoveries had led Chevalier (in 1859) to predict a large fall in the value of gold. But the meaning to be attached to the latter phrase and the method of measurement appropriate to the problem were involved in deep obscurity. Newmarch (in 1857) and McCulloch (in 1858) doubted the existence of any depreciation in the purchasing power of gold,

* *Investigations*, p. 16.

and subsequently in the pages of the *Statistical Journal* (1859, 1860 and 1861) Newmarch had suspended judgment. Jevons had to solve the problem of price index-numbers practically from the beginning*; and it is scarcely an exaggeration to say that he made as much progress in this brief pamphlet as has been made by all succeeding authors put together. He examines the logical and dialectical problem, the question of weighting, the choice between an arithmetic and a geometric mean, whether articles which have moved abnormally should be excluded, and, generally speaking, what classes of commodities can best be taken as representative. He then compiles a series of index numbers based on the average monthly prices of thirty-nine commodities for each of the years 1845 to 1862; and supplements and checks the results by considering a further seventy-nine minor articles. His final conclusion he expressed as follows:—

While I must assert the fact of a depreciation of gold with the utmost confidence, I assign the numerical amount of it with equal diffidence. The lowest estimate of the fall that I arrive at is 9 per cent., and I shall be satisfied if my readers accept this. At the same time, in my own opinion the fall is nearer 15 per cent. It may even be more than this. Many years, however, must pass before numerical estimates can be properly stated to possess more than a slight degree of probability.†

Finally, Jevons examined the social consequences of the change in the value of money, classifying incomes according as they suffer from depreciation, estimating its effect on the Budget and the National Debt, enquiring "Whether a remedy is needful or possible," "Ought gold as a standard of value to be abandoned?" "Have the gold discoveries added to the wealth of the world?" and concluding:—

I cannot but agree with Macculloch, that, putting out of sight individual cases of hardship, if such exist, a fall in the value of gold must have, and, as I should say, has already, a most powerfully beneficial effect. It loosens the country, as nothing else could, from its old bonds of debt and habit. It throws increased rewards before all who are making and acquiring wealth. It excites the active and skillful classes of the community to new exertions, and is, to some extent, like a discharge from his debts to the bankrupt long struggling against his burdens. All this is effected without a breach of national good faith, which nothing could compensate.‡

For unceasing fertility and originality of mind applied, with a sure touch and unflinching control of the material, to a mass of statistics, involving immense labours for an unaided individual plough-

* As was habitual with Jevons, he took great interest in discovering and recording the work of his precursors.

† *Op. cit.*, p. 17.

‡ *Investigations in Currency and Finance*, p. 96.

ing his way through with no precedents and labour-saving devices to relieve his task, this pamphlet stands unrivalled in the history of our subject. The numerous diagrams and charts which accompany are also of high interest in the history of statistical description.

Just as Jevons's study of seasonal fluctuations had led to his detection of the secular movement of prices, so his task of analysing the latter brought to the surface the character of the cyclical movements over the same period. The analysis and elimination of the latter played, indeed, an important part in his controversial objective. For the doubt which existed as to the secular depreciation of gold was due to the movement being overlaid by the price changes of the trade cycle; those who denied the long-period change in the value of the standard, ascribing the observed movements to the familiar alternation of good and bad trade. It was, therefore, necessary for Jevons to endeavour to eliminate the effect of the latter, which led him, incidentally, to date and to measure the trade cycle with a new precision. This was to lead him at a later date to famous conclusions. For the time being his observations on the underlying causes of the trade cycle, though merely *obiter dicta*, strike deeper, in my judgment, than those which he popularized later. He summed them up as follows :—

That great commercial fluctuations, completing their course in some ten years, diversify the progress of trade, is familiar to all who attend to mercantile matters. The remote cause of these commercial tides has not been so well ascertained. It seems to lie in the *varying proportion which the capital devoted to permanent and remote investment bears to that which is but temporarily invested soon to reproduce itself*.*

Were a certain definite proportion of the capital of the country set apart every year for such long-dated investments, the returns of capital which they would make would be as regular as the absorption of capital. But this is not the case. It is the peculiarity of these great and permanent works to be multiplied at particular periods.†

Jevons supported this conclusion by a graph showing annually over a period of thirty-seven years the quantity of bricks made in the United Kingdom, the loads of timber imported and the price of iron—a remarkable example (in what is merely a parenthesis) of the range of Jevons's inductive curiosity and of his intense industry at this period of his life.‡

* Jevons's own italics.

† *Op. cit.*, p. 28.

‡ This parenthesis had been originally a part of the *Statistical Atlas* which he had been working at in 1861. In a letter to his brother (April 7, 1861) he wrote: "The chief interest of the work will be in the light thrown upon the commercial storms of 1793, 1815, 1826, 1839, 1847, 1857, etc., the causes of which will be rendered more or less apparent. I find that the number of Acts of Parliament, the number of patents, and the number of bricks manufactured, are the best indications of an approaching panic, which arises generally from a large investment of labour in works not immediately profitable, as machinery, canals, railways, etc. It is truly curious how well the curve of *bricks produced*

Speaking in this place, it is suitable to mention that at this point Jevons felt himself ripe to apply for membership of our body. In his Journal of June 4, 1864, he wrote :—

I am on the point of getting myself proposed and perhaps elected a Fellow of the Statistical Society, as the use of the title F.S.S., the use of the library, and possible acquaintance with other statisticians, will be of high advantage to me.*

His next contribution, *On the Variation of Prices and the Value of the Currency since 1782*, in which he further developed his theory of index numbers and carried through the immense labour of continuing his series backwards into the eighteenth century, was read before the Statistical Society in May 1865; and in the following year he read before the Society his extensive study *On the Frequent Autumnal Pressure in the Money Market, and the Action of the Bank of England*. These papers were the beginning of a close association, which in 1877 culminated in his becoming one of the secretaries of the Society and a member of the Council. By this time he was resident in London, and frequently attended our meetings. In 1880 he was appointed a Vice-President on resigning his secretaryship.

The four years from 1862 to 1866 had been a period of intense activity of mind.† Jevons was living on the money he had saved in Australia. He had no post, and had a sense of loneliness and failure. Even in the early part of 1866, when his name had been established, his Journal shows that he suffered from anxiety and depression. So is it always. In May 1866 he was appointed Professor of Logic and Mental and Moral Philosophy and Cobden Professor of Political Economy in Owens College, Manchester. "I shall now have about £300 a year from the college," he wrote in his Journal, "and nearly £108 from my own money. What can I not do with it?" But he now had much to do besides think and write; and in 1867 he married. Nearly ten years were to pass before he again attempted a major statistical enquiry.‡

shows this, bricks and mortar being the most enduring form of product. Most of the statistics, of course, are generally known, but have never been so fully combined or exhibited *graphically*. The statistics of patents, and some concerning literature, will be quite new. The mode of exhibiting numbers by curves and lines has, of course, been practised more or less any time on this side the Deluge. At the end of last century, indeed, I find that a book of *Charts of Trade* was published, exactly resembling mine in principle; but in statistics the method, never much used, has fallen almost entirely into disuse. It ought, I consider, to be almost as much used as *maps* are used in geography." (*Letters and Journal*, pp. 157, 158.)

* *Letters and Journal*, p. 199.

† In addition to what I have recorded, his *Pure Logic, or the Logic of Quality apart from Quantity, with Remarks on System and on the Relation of Logic and Mathematics* was published in 1863.

‡ His paper *On the Condition of the Gold Coinage of the United Kingdom, with reference to the question of International Currency*, read before the Statistical Society in 1868, is of secondary importance, though ingenious and laborious.

It is often forgotten how comparatively late in his career Jevons developed the theory of solar variation as the explanation of the period of the Trade Cycle, which is immortally associated with his name. It was published in two papers read before the British Association in 1875 and 1878. The first of these papers is brief and goes little further than to suggest a matter for enquiry. In 1801 Sir William Herschel had "endeavoured to discover a connection between the price of corn and the power of the sun's rays as marked by the decennial variation of the sun's spots." * In 1861 R. C. Carrington, "in his standard work upon the sun, gave a diagram comparing the price of corn with the sunspot curve during portions of the last and present centuries." † The results of both these enquiries were negative. But Arthur Schuster, Jevons's colleague at Owens College, revived the matter by pointing out "that the years of good vintage in Western Europe have occurred at intervals somewhat approximating to eleven years, the average length of the principal sunspot cycle." ‡ Thorold Rogers' *History of Agriculture and Prices in England*, which began to appear in 1866, provided Jevons with material for analysing wheat prices over a long period. The commercial crises in his own lifetime had occurred at intervals of ten or eleven years: 1825, 1836-39, 1847, 1857, 1866. Might there not be a connection between these things? "I am aware," Jevons concluded, "that speculations of this kind may seem somewhat far-fetched and finely-wrought; but financial collapses have recurred with such approach to regularity in the last fifty years, that either this or some other explanation is needed." § Nevertheless, he soon repented of publishing what was no better than a bright idea. "Subsequent enquiry convinced me that my figures would not support the conclusion I derived from them, and I withdrew the paper from publication." ||

The virus, however, had entered into his system. No one who has once deeply engaged himself in coincidence-fitting of this character will easily disembarass himself of the enquiry. In 1878 Jevons returned to it in his second paper before the British Association, and in an article contributed to *Nature* in which the argument was recapitulated. Three new discoveries were his excuse. In the first place, he had succeeded in carrying back the history of commercial crises at ten- or eleven-year intervals almost to the beginning of the eighteenth century. In the second place, he was now advised by his astronomical friends that the solar period was not

* *Investigations*, p. 206.

† *Op. cit.*, p. 195.

‡ *Op. cit.*, p. 195.

§ *Op. cit.*, p. 204.

|| *Op. cit.*, p. 207. The paper was reprinted posthumously in the *Investigations in Currency and Finance*.

11.1 years, as he had previously supposed, but 10.45 years, which fitted much better his series of commercial crises. In the third place, he now abandoned European harvests, the price statistics for which yielded negative results, as the intermediary through which sunspots affected business, in favour of Indian harvests, which, he argued, transmitted prosperity to Europe through the greater margin of purchasing power available to the Indian peasant to buy imported goods.*

Jevons's argument is by no means so clear as is usual with him. He produced considerable evidence for the view that commercial crises had occurred at intervals of about 10½ years. The astronomers told him that the solar period was about 10½ years. This "beautiful coincidence," as he called it, produced in him an unduly strong conviction of causal nexus. "I beg leave to affirm," he wrote in his article for *Nature*, "that I never was more in earnest, and that after some further careful enquiry, I am perfectly convinced that these decennial crises do depend upon meteorological variations of like period."† But he devoted far too little attention to the exact dating of deficient harvests in relation to the dating of commercial crises, which was a necessary first step to tracing the intermediate links. In his paper of 1875, when he believed his evidence to depend on European harvests, he discovered the link in the spirit of optimism produced by good crops:—

Mr. John Mills in his very excellent papers upon Credit Cycles in the *Transactions of the Manchester Statistical Society* (1867-68) has shown that these periodic collapses are really mental in their nature, depending upon variations of despondency, hopefulness, excitement, disappointment and panic.‡ . . . Assuming that variations of commercial credit and enterprise are essentially mental in their nature, must there not be external events to excite hopefulness at one time or disappointment and despondency at another? It may be that the commercial classes of the English nation, as at present constituted, form a body suited by mental and other conditions to go through a complete oscillation in a period nearly corresponding to that of the sunspots. In such conditions a comparatively slight variation of the prices of food, repeated in a similar manner, at corresponding points of the oscillation, would suffice to produce violent effects.§

But in 1878 he described this theory as a "rather fanciful hypothesis,"|| and made everything to depend on the decennial fluctuations in foreign trade consequent on cyclical crop changes in India and

* Mr. J. C. Ollerenshaw had explained in a communication to the Manchester Statistical Society in 1869 "that the secret of good trade in Lancashire is the low price of rice and other grain in India" (*op. cit.*, p. 236).

† *Op. cit.*, p. 235.

‡ Already in 1869 (in his Inaugural Address to the Manchester Statistical Society) Jevons had adopted Mills's theory of the trade cycle.

§ *Op. cit.*, pp. 203-4.

|| *Op. cit.*, p. 226.

elsewhere. Unfortunately this involved a difficulty in dating which he passes over with surprising levity:—

One difficulty which presents itself is that the commercial crises in England occur simultaneously with the high prices in Delhi, or even in anticipation of the latter; now the effect cannot precede its cause, and in commercial matters we should expect an interval of a year or two to elapse before bad seasons in India made their effects felt here. The fact, however, is that the famines in Bengal appear to follow similar events in Madras.*

Thus the details of the inductive argument are decidedly flimsy. If, however, it could be established that, generally speaking and on the average of different crops and countries, years when the world draws for current consumption on the stocks carried forward from one harvest to another alternate, in accordance with the solar period, with years when bountiful harvests serve to increase the stocks carried forward, Jevons could have linked his thesis, on the broadest possible grounds, with his forgotten theory of 1863 that the trade cycle depended on fluctuations of investment. For alternating investment and disinvestment in the aggregate stocks of the produce of the soil held in excess of current consumption might be capable of consequences closely analogous to those he had previously ascribed to fluctuations in the rate of new investment in durable goods.

Whether or not Jevons was wrong or rash in the hypotheses he framed on the basis of his inductive studies, it was a revolutionary change, for one who was a logician and a deductive economist, to approach the subject in this way. By using these methods Jevons carried economics a long stride from the *à priori* moral sciences towards the natural sciences built on a firm foundation of experience. But the material of economics is shifting as well as complex. Jevons was pursuing a singularly difficult art, and he has had almost as few successors as predecessors, who have attained to his own level of skill.

The sun-spot papers cannot be ranked on at all the same plane of genius or of achievement as *A Serious Fall in the Value of Gold*. Since his time, unfortunately for his conclusions, the astronomers have reverted to 11·125 as the average of the solar period,† whilst the trade cycles have recurred at intervals of 7 or 8, rather than of 10 or 11 years. In 1909 the problem was reconsidered in an ingenious manner by his son Prof. H. S. Jevons,‡ who argued that the harvest

* *Op. cit.*, pp. 239–40.

† Whilst this is now believed to be the *average* interval, it is not a uniform one; and over the limited period which Jevons had particularly examined the average interval actually was, as he believed, about 10·45 years.

‡ *The Sun's Heat and Trade Activity*, supplemented by his paper on "The Causes of Fluctuations of Industrial Activity and the Price-level," *Statistical Journal* (1933), vol. XCVI, pp. 545–605.

statistics could be interpreted in terms of a $3\frac{1}{2}$ -year cycle, which was combined in twos or threes to produce either 7- or $10\frac{1}{2}$ -year periods. This was followed up after the War by Sir William Beveridge's much more elaborate studies of harvest statistics, which led him to the conclusion of a complex 15.2-years period which he further analysed into sub-periods.* It is now generally agreed that, even if a harvest period can be found associated with the solar period or with more complex meteorological phenomena, this cannot afford a complete explanation of the trade cycle. The theory was prejudiced by being stated in too precise and categorical a form. Nevertheless, Jevons's notion, that meteorological phenomena play a part in harvest fluctuations and that harvest fluctuations play a part (though more important formerly than to-day) in the trade cycle, is not to be lightly dismissed.

IV.

Meanwhile Jevons was contributing with equal originality to the study of deductive economics based on simplified and abstract assumptions. His thoughts can be traced back to his period of solitary thought in Australia in 1858-9 when he was 22 or 23 years old.† By 1860, when he was working at University College, a definite theory was taking shape in his mind. On June 1, 1860, he wrote to his brother Herbert :—

During the last session I have worked a good deal at political economy; in the last few months I have fortunately struck out what I have no doubt is *the true Theory of Economy*, so thorough-going and consistent, that I cannot now read other books on the subject without indignation. While the theory is entirely mathematical in principle, I show, at the same time, how the data of calculation are so complicated as to be for the present hopeless. Nevertheless, I obtain from the mathematical principles all the chief laws at which political economists have previously arrived, only arranged in a series of definitions, axioms, and theories almost as rigorous and connected as if they were so many geometrical problems. One of the most important axioms is, that as the quantity of any commodity, for instance, plain food, which a man has to consume, increases, so the utility or benefit derived from the last portion used decreases in degree. The decrease of enjoyment between the beginning and end of a meal may be taken as an example. And I assume that on an average, the *ratio of utility* is some continuous mathematical function of the quantity of commodity. This law of utility has, in fact, always been assumed by political economists under the

* Published in articles in the *Economic Journal* in 1920 and 1921 and in the *Statistical Journal* in 1922. In the discussion at the Statistical Society serious objections were raised by Mr. Yule and others to the further analysis of the (apparent) 15.2-years period.

† In December 1862 he wrote in his Journal: "I thought what I did very clever then (*i.e.* in Sydney), but it seems foolishness to me now and my first efforts at a theory of economy look strange beside the theory which has gradually opened before me."

more complex form and name of the Law of Supply and Demand. But once fairly stated in its simple form, it opens up the whole of the subject. Most of the conclusions are, of course, the old ones stated in a consistent form; but my definition of capital and law of the interest of capital are, as far as I have seen, quite new. I have no idea of letting these things lie by till somebody else has the advantage of them, and shall therefore try to publish them next spring.*

More than two years passed by, however, before the outline of his theory was made public. Jevons sent a short paper entitled *Notice of a General Mathematical Theory of Political Economy* to Section F of the British Association to be read in his absence before the 1862 Meeting held at Cambridge, where Marshall was an undergraduate in his first year. He had no diffidence about its worth and high, though doubtful, hopes about its effect. He wrote to his brother in September 1862:—

Although I know pretty well the paper is perhaps worth all the others that will be read there put together, I cannot pretend to say how it will be received—whether it will be read at all, or whether it won't be considered nonsense. . . . I am very curious, indeed, to know what effect my theory will have both upon my friends and the world in general. I shall watch it like an artilleryman watches the flight of a shell or shot, to see whether its effects equal his intentions.†

The paper attracted no attention whatever and was not printed, the Secretary of the British Association writing to him that "a further explanation and publication of the above-mentioned theory is deferred until a more suitable period for establishing a matter of such difficulty." Four years later it was published in the *Statistical Journal* (June 1866), where it occupies about five pages.‡ Though to a modern reader Jevons's 27 paragraphs are perfectly lucid, they are little more than an abstract or syllabus of a complete theory. But the substance of all his subsequent ideas is there. A hedonistic calculus allows us to balance the utility of consumption against the disutility of labour. The price of a commodity is determined not by its aggregate utility but by balancing the marginal utility of its consumption, or, as he here expresses it, "the coefficient of utility (which) is the ratio between the last increment or infinitely small supply of the object, and the increment of pleasure which it occasions," against the marginal disutility of its production, "labour (being) exerted both in intensity and duration until a further increment will be more painful than the increment of produce thereby obtained is pleasurable."§ The amount of capital is estimated by the amount of utility of which the enjoyment is deferred. . . . As labour must be supposed to be aided with some

* *Letters and Journal*, p. 151.

† *Loc. cit.*, p. 169.

‡ Reprinted (as an appendix) in the fourth edition of Jevons's *Theory of Political Economy*, edited by H. S. Jevons in 1911.

§ *Statistical Journal* (1866), vol. XXIX, pp. 283, 284.

capital, the rate of interest is always determined by the *ratio which a new increment of produce bears to the increment of capital by which it was produced.*"* In a concluding sentence the extent of his departure from the classical school is indicated: "The interest of capital has no relation to the absolute returns to labour, but only to the increased return which the last increment of capital allows."†

Another five years passed by before this abstract, which had attracted no more attention than at its first reading, was fully clothed, *The Theory of Political Economy* being published in October 1871. Prof. H. S. Jevons records‡ that "according to one of my father's MS. notes,§ the publication might have been delayed considerably later than 1871 had it not been for the appearance in 1868 and 1870 of articles by Professor Fleeming Jenkin." The book follows very closely both the order and substance of the abstract of nearly ten years before. But it carries out what was only the promise of the latter to "reduce the main problem of this science to a mathematical form," by introducing diagrams and expressing the argument in mathematical form with a frequent use of the notation of the differential calculus.

Jevons's *Theory of Political Economy* and the place it occupies in the history of the subject are so well known that I need not spend time in describing its contents. It was not as uniquely original in 1871 as it would have been in 1862. For, leaving on one side the precursors Cournot, Gossen, Dupuit, Von Thünen and the rest, there were several economists, notably Walrus and Marshall, who by 1871, were scribbling equations with x 's and y 's, big Deltas and little d 's. Nevertheless, Jevons's *Theory* is the first treatise to present in a finished form the theory of value based on subjective valuations, the marginal principle and the now familiar technique of the algebra and diagrams of the subject. The first modern book

* *Loc. cit.*, p. 286.

† *Loc. cit.*, p. 287.

‡ In editing the fourth edition of *The Theory*, p. lvii.

§ This note (as nearly as I can decipher it—written, as usual, on the back of an old envelope) runs as follows:—

"In regard to this & certain other essays of Professor Fleeming Jenkin, it seems desirable that I should make the following explanation, to prevent misapprehension. My theory was originally read at the Brit. Assoc. in 1862, & printed in the *Stat Journal* in 1867 (*sic*). In March 1868 Prof Jenkin wrote an article for the *Br. Quarterly Review* (*sic*) in which he restated (?) . . . the law of supply & demand in math language. He courteously sent a copy to me and requested my opinion thereon; in replying I sent a copy of the paper mentioned above, & a correspondence ensued concerning the correctness of the theory, in the course of which curves were used in illustration by both parties.

In 1870 appeared Prof. Jenkins "Graphic Illustration (*sic*)" in which no reference is made to my previous (?).

Partly in consequence of this I was led to write & publish the *Theory* in 1871.

In 1872 Prof. Fleeming Jenkin published in the *Proceedings of the Roy Soc Edin* (?).

on economics, it has proved singularly attractive to all bright minds newly attacking the subject;—simple, lucid, unflinching, chiselled in stone where Marshall knits in wool. Let me open it almost at random and quote you a passage to remind you of its quality:—

The fact is, that *labour once spent has no influence on the future value of any article*: it is gone and lost for ever. In commerce by-gones are for ever by-gones; and we are always starting clear at each moment, judging the values of things with a view to future utility. Industry is essentially prospective, not retrospective; and seldom does the result of any undertaking exactly coincide with the first intentions of its promoters.

But though labour is never the cause of value, it is in a large proportion of cases the determining circumstance, and in the following way: *Value depends solely on the final degree of utility. How can we vary this degree of utility?—By having more or less of the commodity to consume. And how shall we get more or less of it?—By spending more or less labour in obtaining a supply.* According to this view, then, there are two steps between labour and value. Labour affects supply, and supply affects the degree of utility, which governs value, or the ratio of exchange. In order that there may be no possible mistake about this all-important series of relations, I will re-state it in a tabular form, as follows:

*Cost of production determines supply ;
Supply determines final degree of utility ;
Final degree of utility determines value.**

In recent times Jevons has received special praise for his Theory of Capital, inasmuch as he anticipated the Austrian School by emphasizing as two distinct dimensions the quantity of capital and the period for which it has to be employed in order to yield up its product. Nevertheless, his treatment as a whole is somewhat vitiated (as Prof. Robbins has pointed out) by echoes of “wage-fund” ideas. Capital, according to Jevons, “consists merely in the aggregate of those commodities which are required for sustaining labourers of any kind or class engaged in work.” † He prefers to say, “not that a factory, or dock, or railway, or ship *is* capital, but that *it represents so much capital sunk in the enterprise.*” “Accordingly, I would not say that a railway *is* fixed capital, but that *capital is fixed in the railway.* The capital is not the railway, but the food of those who made the railway.” ‡ On the other hand, there are admirable passages where he conceives of capital as being measured on the supply side by the amount of the present utility foregone and on the demand side by the discounted value of the future utilities expected from it.

It is somewhat surprising that even the book did not win any immediate success.§ The only reviews of importance were those by Cairnes, representing the older generation, and by Alfred Marshall,

* *Theory of Political Economy*, p. 164.

† *Theory of Political Economy* (4th ed.), p. 223.

‡ *Op. cit.*, p. 243.

§ Seven years passed before it had sold 1,000 copies.

representing the younger, in what was the latter's first appearance in print. Cairnes declared that ignorance of mathematics made most of the book unintelligible to him, but this did not prevent him from concluding that it was all wrong. Marshall's review was tepid and grudging. "We may read far into the present book," he wrote, "without finding any important proposition which is new in substance." * "The main value of the book does not lie in its more prominent theories, but in its original treatment of a number of minor points, its suggestive remarks and careful analogies." † And he characteristically concludes: "The book before us would be improved if the mathematics were omitted, but the diagrams retained." ‡ Jevons, writing to a correspondent, commented as follows: "There was indeed a review in the *Academy* of 1st April, 1872, but though more fair than that of the *Saturday Review*, it contained no criticism worthy of your notice." § So late as 1874 Jevons wrote:—

While I am not aware that my views have been accepted by any well-known English economist, there are a certain number of younger mathematicians and economists who have entered into the subject, and treated it in a very different manner. Among these I may mention Mr. George Darwin, the son of the eminent naturalist; he is a very good mathematician and an acute economist.||

The relations between Jevons and Marshall are of some interest. Nearly twenty years later, and eight years after Jevons's death, the references to Jevons in the *Principles* are still somewhat grudging.¶ Marshall was extraordinarily reluctant to admit that he owed anything to Jevons. There is no evidence that Jevons was aware of the authorship of the *Academy* review. He never visited Cambridge before 1874, when he first examined in the Moral Sciences Tripos. "The only time I saw him," Mrs. Marshall writes to me, "was in 1874 when he was one of my examiners and gave rise to Dr. Kennedy's lines:

"Were they at sixes and at sevens?

Oh Pearson Gardiner Foxwell Jevons." **

* *Memorials of Alfred Marshall*, p. 94.

† *Loc. cit.*, p. 95.

‡ *Loc. cit.*, p. 99.

§ *Letters and Journal*, p. 309.

|| *Loc. cit.*, p. 311 (in the same letter as that from which the immediately preceding quotation is taken).

¶ *Vide my Essays in Biography*, pp. 186-188.

** When *The Economics of Industry*, by Alfred and Mary Marshall, was published in 1879, the authors sent Jevons a copy, which is now in the possession of his son. At the beginning and at the end Jevons has pasted in letters from Marshall. In the first of these, printed in *Memorials of Alfred Marshall*, p. 371, Marshall speaks of "the results of abstract quantitative reasoning in Economics of which I recognize in you the chief author." The second responds to Jevons's acknowledgment of the book and begins: "My dear Jevons, My wife and I have often wondered what you would think of our book; we were more anxious for your good opinion of it than for anyone else's. . . ." When Marshall applied for an appointment at Bristol (1877), Jevons furnished him with a testimonial (*vide my Essays in Biography*, p. 195).

He was, of course, close friends with Professor Foxwell, with whom he frequently corresponded, and whom he again visited at Cambridge towards the end of 1880. In a letter of Jevons's to Professor Foxwell written in 1875 and again in 1879 there are echoes of talk in which Professor Foxwell seems to have been advancing Marshall's claims. In 1875 Jevons writes :—

I have been very much interested in your letter concerning my paper. It has told me much, which I had no previous means of knowing, concerning the ideas current in philosophical subjects in Cambridge. I was not aware that Marshall had so long entertained notions of a quantitative theory of political economy, and think it a pity that he has so long delayed publishing something on the subject.

It is, of course, open to you or him or others to object to the special way in which I have applied mathematics, and I should like to see other attempts in different directions, but what I contend is that my notion of utility is the correct one, and the only sound way of laying the foundation for a mathematical theory.*

And in 1879 :—

As regards the analogy of the laws of wages and rents, of course I do not know what Marshall gave in his lectures in 1869, as I neither attended them nor have seen notes, unless, indeed, the answers of some of the candidates. But I do not remember that they said anything on the matter. . . .

As regards Marshall's originality, I never called it in question in the slightest degree, having neither the wish nor the grounds. On the other hand, you seem to forget that the essential points of my theory were fully indicated as far back as 1862, at the Cambridge Meeting of the British Association. I have no reason to suppose that Marshall saw any printed report of my first brief paper; but of course, on the other hand, in my book of 1871 (*Theory of Political Economy*) I could not possibly have borrowed anything from Marshall. But these questions are really of little or no importance now that we have found such earlier books as those of Gossen, Cournot, Dupuit, etc. We are all shelved on the matter of priority, except, of course, as regards details and general method of exposition, etc.†

Jevons omits to point out that an abstract of his whole theory had been printed in the *Statistical Journal* in 1866—not a very obscure source. Indeed, it was preposterous to suggest that Jevons could have derived anything from Marshall. But for more than another decade after Jevons wrote the above, " what Marshall gave in his lectures in 1869 " was to be an inhibition and a taboo on the publications of others. In later years Marshall was, perhaps, a little uneasy whether a certain fundamental lack of sympathy had led him to do injustice to Jevons. The following undated ‡ fragment was found amongst his papers :—

I looked with great excitement for Jevons's *Theory* : but he gave me no help in my difficulties and I was vexed. I have since learnt to estimate him better. His many-sidedness, his power of combining

* *Letters and Journal*, p. 331.

† *Loc. cit.*, p. 408.

‡ Apparently written in 1897.

statistical with analytical investigations, his ever fresh honest sparkling individuality and suggestiveness impressed me gradually; and I reverence him now as among the very greatest of economists. But even now I think that the central argument of his *Theory* stands on a lower plane than the work of Cournot and von Thünen. They handled their mathematics gracefully: he seemed like David in Saul's armour. They held a mirror up to the manifold interactions of nature's forces: and, though none could do that better than Jevons when writing on money or statistics or on practical issues, he was so encumbered by his mathematics in his central argument, that he tried to draw nature's actions out into a long queue. This was partly because the one weakness of his otherwise loyal and generous character showed itself here: he was impressed by the mischief which the almost pontifical authority of Mill exercised on young students; and he seemed perversely to twist his own doctrines so as to make them appear more inconsistent with Mill's and Ricardo's than they really were. But the genius which enabled Ricardo—it was not so with Mill—to tread his way safely through the most slippery paths of mathematical reasoning, though he had no aid from mathematical training, had made him one of my heroes; and my youthful loyalty to him boiled over when I read Jevons' *Theory*. The editor of the *Academy* having heard that I had been working on the same lines, asked me to review the book: and, though a quarter of a century has passed, I have a vivid memory of the angry phrases which would force themselves into my draft, only to be cut out and then reappear in another form a little later on, and then to be cut out again. . . . On many aspects of economics I have learnt more from Jevons than from any one else. But the obligations which I had to acknowledge in the Preface to my *Principles* were to Cournot and von Thünen and not to Jevons.*

This passage brings to the surface a deeper cause of the lack of sympathy between these two founders of modern economics than a sense of rivalry arising out of the similarity of their approach—namely, out of their *dissimilarity* in standing, each with the deep emotion which the subject commands, on opposite sides in the still unresolved debate whether Ricardo was a true or a false prophet. In 1875 Jevons wrote to Professor Foxwell:—

"I am beginning to think very strongly that the true line of economic science descends from Smith through Malthus to Senior, while another branch through Ricardo to Mill has put as much error into the science as they have truth."† And the preface to the second edition of his *Theory of Political Economy* (1879) concludes as follows:—

When at length a true system of Economics comes to be established, it will be seen that that able but wrong-headed man, David Ricardo,

* *Memorials of Alfred Marshall*, p. 99. To this may be added Marshall's tribute to Jevons printed by Professor Foxwell in his introduction (p. xlii) to the *Investigations in Currency and Finance*, to the effect that the great body of Jevons's work "will probably be found to have more constructive force than any save that of Ricardo, that has been done during the last hundred years," and that "the pure honesty of Mr. Jevons's mind, combined with his special intellectual fitness for the work, have made them models for all time."

† *Letters and Journal*, p. 344.

shunted the car of Economic science on to a wrong line, a line, however, on which it was further urged towards confusion by his equally able and wrong-headed admirer John Stuart Mill. There were Economists, such as Malthus and Senior, who had a far better comprehension of the true doctrines (though not free from the Ricardian errors), but they were driven out of the field by the unity and influence of the Ricardo-Mill school. It will be a work of labour to pick up the fragments of a shattered science and to start anew, but it is a work from which they must not shrink who wish to see any advance of Economic Science.*

The violence of Jevons's aversion to Mill, pursued almost to the point of morbidity, is well known. All Jevons's nonconformist heredity rose up against the orthodoxy which the prestige of Mill in the 'sixties and 'seventies imposed on the subject and particularly on its educational side. He wrote to a correspondent in 1874 :—

I fear it is impossible to criticize Mr. Mill's writings without incurring the danger of rousing animosity, but I hope and believe you are right in saying that I have said nothing from petulance or passion. Whatever I have said or shall say of Mr. Mill is due to a very long consideration of his works, and to a growing conviction that, however valuable they are in exciting thought and leading to the study of social subjects, they must not be imposed upon us as a new creed.†

Of the younger men with whom he was intimate, he fully converted Professor Foxwell to his point of view, and it was a bond of sympathy. But he could not forgive Edgeworth, with whom he used to walk on Hampstead Heath, by which they both lived in the last years of his life, for being "still deep in the fallacies of Mill." The aversion had some of its roots, I think, in a personal experience. In 1860, shortly after his return from Australia, he was working at University College for the B.A. degree. At this time his own theories were seething in his head.‡ In his heart he believed himself to be in embryo the only economist in the world with a conception of the truth. This was a dangerous state of mind for an examinee, and after the College Examinations in June, 1860, he has to confess :—

In political economy I had a sad reverse, such indeed as I never had before, for in spite of having studied the subject independently and originally, and having read some dozens of the best works in it, almost neglecting other classes for the purpose, I was placed third or fourth when I felt confident of the first prize. This I can only attribute to a difference of opinion, which is perfectly allowable, having prejudiced the professor against my answers. However, I shall fully avenge myself when I bring out my *Theory of Economy*, and re-establish the science on a sensible basis.§

It is interesting to record that the first prize was awarded to H. H. Cozens-Hardy, afterwards Master of the Rolls, who was,

* *Theory of Political Economy* (2nd ed.), p. lvii.

† *Letters and Journal*, p. 329.

‡ Cf. the letter to his brother written at this time from which I have quoted above, p. 531.

§ *Letters and Journal*, p. 154.

however, three years Jevons's junior, and that in the examination for the Ricardo Scholarship in Political Economy, a few months later in the same year, Jevons defeated Cozens-Hardy and was awarded the scholarship.* Moreover in the June examination in Philosophy of Mind and Logic Jevons was bracketed first (with Theodore Waterhouse). So he had not, in fact, much to complain of. Nevertheless the effect on his mind was curious. The students whom he had to teach when he became Professor at Owens College were accustomed to sit for the London examinations. As he thought it would be unfair to expose his own pupils to the rebuff he himself had suffered, his conscience did not allow him to teach them his own characteristic doctrine. His courses at Manchester were mainly confined to an exposition of Mill.† I had long ago heard this from my father, and how this repression of his own theories had brought his feeling against Mill to boiling point. A book of careful lecture notes taken down by a member of his class, which I lately came across, confirms that this was so.‡

* This and other information relating to the teaching of Economics at University College has been very kindly supplied to me by Miss C. E. Collet (who was examined by Jevons in 1880 in the philosophical subjects for the London B.A.). She tells me that the sessional examination was confined to the work done during the year under the Professor (Jacob Waley, who was more of a lawyer than an economist), and gave little scope for showing superiority outside this course, whereas the scholarship examination was wider and brought in an external examiner (R. H. Hutton in 1860, Bagehot having been the external examiner in the previous year). The actual papers set are to be found in the U.C.L. Calendars for 1860-1 and 1861-2.

† In explaining his methods of teaching at Owens College (*Letters and Journal*, p. 284) he writes: "I have generally followed somewhat the order of subjects in Mill's Pol. Econ. in perfect independence, however, of his views and methods when desirable. In the subject of currency I have always abandoned his book altogether." But this fell far short, I believe, of his venturing to teach the marginal principle and other characteristic doctrines of his own *Theory*; whilst on currency his own outlook did not differ significantly from Mill's. (Cf. also *Letters and Journal*, p. 409, where many years later (1879) he defended his recommendation of Mill's *Political Economy* for the Bankers' Institute examinations on the ground that "it is one thing to put forward views for rational judgment of competent readers, it is another thing to force these views on young men by means of examinations." Miss Collet tells me that, since *Political Economy* was a subject only for the London M.A. degree and not for the London B.A., those of Jevons's pupils at Owens College who sat for the London examinations in *Political Economy* were very few indeed as compared with those who sat in *Logic* for the B.A. examination, and she argues that Jevons's irritation against Mill was concerned more with his *Logic* than with his *Political Economy*. But there can, I think, be little doubt as to the strength of Jevons's hostility to Mill's *Political Economy*, at least equally with his *Logic*.

‡ Some qualification to the above is suggested by the following note appended by Jevons in his list of his mathematico-economic books: "From about the year 1863 I regularly employed intersecting curves to illustrate the determination of the market price in my lectures at Owens College." The lecture notes referred to above do, indeed, include a sketch of a demand curve, but the accompanying text contains no reference to the marginal principle.

V.

In my memoir of Alfred Marshall I called attention to the many-sidedness which seems to be a necessary equipment for an economist.* Jevons was certainly a notable example of this. To his scientific and experimental training which led him to his inductive studies and his logical and analytical bent which led him to his deductive studies there was added an unusually strong historical, and even antiquarian, bias. From his earliest days Jevons had a native inclination to carry his inductive studies backwards in point of time, and to discover the historical origins of any theory in which he was interested. This is first apparent in the quantity of historical material with which he adorned the *Coal Question*, material much of which it would have occurred to few other authors to bring in. He carried back his series of index numbers into the eighteenth century. When he came to study solar variations, he traced back the history of the trade cycle to the beginning of the eighteenth century and examined harvest statistics over many centuries. Thus in the field of economic history he made himself a pioneer in the history of prices and of trade fluctuations.

In the history of economic thought and theory he was even more deeply interested. In every branch of the subject that he touched he sought out the unknown or forgotten precursors of his favourite theories. His most brilliant contribution in this field was his discovery of the work and significance of Cantillon; whilst his most substantial contribution was his pioneer work in economic bibliography summed up in his hand-list of "Mathematico-Economic Books, Memoirs, and other published Writings," printed as an appendix to the second edition of his *Theory of Political Economy* and in his handlist of writings on monetary problems appended to the *Investigations in Currency and Finance*.

Beyond this, Jevons was a born collector, the first of the distinguished tribe of economic bibliomaniacs who have contrived to set a fashion amongst librarians which has entitled the booksellers to run the obscurest fragments of economic literature up to fancy

* There are many passages which show Jevons's own awareness of the complex qualities required by an economist. Vide *Letters and Journal*, p. 101 (also pp. 116-18): "*Economy*, scientifically speaking, is a very contracted science; it is in fact a sort of vague mathematics which calculates the causes and effects of man's industry, and shows how it may best be applied. There are a multitude of allied branches of knowledge connected with man's condition; the relation of these to political economy is analogous to the connection of mechanics, astronomy, optics, sound, heat, and every other branch more or less of physical science, with pure mathematics. . . . There are plenty of people engaged with physical science, and practical science and arts may be left to look after themselves, but thoroughly to understand the principles of society appears to me now the most cogent business."

figures. Jevons invented the collecting of obscure economic books and pamphlets; though it was, of course, Lord Macaulay who first drew attention to their importance as historical sources. Professor Foxwell * first caught the affliction from him; though Jevons never paid high prices or proceeded to the extremest stages where condition and collector's "points" are paramount,—his was primarily a far-flung working library for which any usable copy would do. Nevertheless, there are entries scattered through his letters tantalizing to the modern collector. On April 8, 1879, he writes to his wife from The Three Swans, Salisbury:—

I have done a great stroke in book-buying, having bought a remarkable collection of nearly five hundred economical and political pamphlets at about a halfpenny each. Some of them are evidently valuable and rare. One of them contains copperplate diagrams of prices for some centuries. One or two are by Robert Owen. I also got a carefully-written list of them all, as good as a catalogue.†

In 1881 he writes from Paris:—

A large part of my time has been taken up in book-hunting on the banks of the Seine. I have secured almost a trunkfull of books on economics, of much scientific and historic value, but often at ridiculously low prices.‡

His wife records:—

On a leisure afternoon he thoroughly enjoyed making a round of several old bookshops, and his kindly, courteous manners—as courteous always to his inferiors in position as to those of his own station—were fully appreciated by the owners. At two at least of the shops which he most frequented he was regarded as a friend, and the booksellers took a pleasure in looking out at the sales they attended for the books they thought might suit him, reserving them from their other customers until he had seen them.§

By the end of his life he had accumulated several thousand volumes, lining the walls and passages of the house and packed in heaps in the attics, an embarrassment to his wife and family both then and in their subsequent removals. These latter led to the gradual dispersal of the books. In 1907 the Library of Owens College, Manchester, was given the first choice to take what they wanted and some 2,400 volumes are incorporated in that library with a special label. After

* "Why," said Jevons to Foxwell one day, "don't you walk sometimes down Great Portland Street" (then a centre of the secondhand booksellers, especially where it joins the Euston Road, as it is to-day of secondhand cars), "there are few days I don't find something there." And that, Prof. Foxwell tells me, was the beginning. In 1881 he wrote to Prof. Foxwell: "I hear of you at the booksellers' occasionally, and fancy you must be getting a good collection of economic books," a remark which has remained *à propos* any day in the fifty-five years since then.

† *Letters and Journal*, p. 397.

‡ *Letters and Journal*, p. 436.

§ *Letters and Journal*, p. 428.

that the Library of University College, London, was given the opportunity to take some hundreds. Out of the residue his son, Prof. H. S. Jevons maintained a working collection, mainly of the more modern books, which he added to the notable economics library which he had built up at the University of Allahabad, when he gave up his Professorship there. Jevons also had a collection of old bank-notes which he described as "such a collection as probably hardly anyone else has."*

VI.

We have now traversed Jevons's outstanding contributions to Economics and Statistics. But we are far from having surveyed the whole of his work. During his lifetime the reputation of Jevons as a logician stood nearly as high as his reputation as an economist. The English school of Logic of the post-Mill period has not held its own in the judgment of modern opinion, and the interest of Jevons's work has declined along with that of his contemporaries. But during the second phase of his work from about 1866 to 1876 logic occupied a large part of his time and thought, and also (so long as he was at Owens College) of his teaching duties. More than half of the books published during his lifetime related to logic. One of them, *The Principles of Science, A Treatise on Logic and Scientific Method*, is his largest work, and was widely used for many years. Nevertheless, the part Jevons played in the development of logic is in no way comparable to his position in the history of Economics and Statistics. It is, however, no part of my present task to review his contributions to knowledge in that field.

In the last decade of his life he discovered in himself a remarkable aptitude for writing in a simple, clear and interesting style the elementary outlines of his favourite subjects. Apart from numerous editions printed in America and in six or seven foreign languages, there have sold up to the present time 130,000 copies of his *Elementary Lessons in Logic* (published in 1870), 148,000 copies of his *Primer of Logic* (1876), and 98,000 copies of his *Primer of Political Economy* (1878). Another elementary book, though on a somewhat larger scale, his *Money and the Mechanism of Exchange* (1875), has sold about 20,000 copies in this country, apart from large sales in America, where there was at one time a cheap pirated edition. For a period of half a century practically all elementary students both of Logic and of Political Economy in Great Britain and also in India and the Dominions were brought up on Jevons. His little books involve few perplexities, are never dull, and give the effect of lucidity and certainty of outlook without undue dogmatism,—indeed ideal for the

* *Op. cit.*, p. 421.

purpose. Simple and definite examination questions can be set upon them;—no blame to them in the eyes of Jevons, who was, rightly, a great believer in the system of examinations which was one of the great contributions of his generation to education and administration. The conclusion of his article on “Cram,” published in *Mind* (1877), is worth quoting:—

I should not venture to defend University examinations against all the objections which may be brought against them. My purpose is accomplished in attempting to show that examination is the most effective way of enforcing a severe and definite training upon the intellect, and of selecting those for high position who show themselves best able to bear this severe test. It is the popular cry against “Cram” that I have answered, and I will conclude by expressing my belief that any mode of education which enables a candidate to take a leading place in a severe and well-conducted open examination, must be a good system of education. Name it what you like, but it is impossible to deny that it calls forth intellectual, moral, and even physical powers, which are proved by unquestionable experience to fit men for the business of life.

This is what I hold to be Education. We cannot consider it the work of teachers to make philosophers and scholars and geniuses of various sorts: these, like poets, are born, not made. Nor, as I have shown, is it the business of the educator to impress indelibly upon the mind the useful knowledge which is to guide the pupil through life. This would be “Cram” indeed. It is the purpose of education so to exercise the faculties of mind that the infinitely various experience of after-life may be observed and reasoned upon to the best effect. What is popularly condemned as “Cram” is often the best-devised and best-conducted system of training towards this all-important end.*

Finally, in the last period of his life Jevons became much interested in the relation of the State to the economic life of the community. On the side of morals and sentiment Jevons was, and always remained, an impassioned individualist. There is a very odd early address of his, delivered to the Manchester Statistical Society in 1869,† in which he deploras free hospitals and medical charities of all kinds, which he regarded as undermining the character of the poor (which he seems to have preferred to, and deemed independent of, their health). “I feel bound,” he said, “to call in question the policy of the whole of our medical charities, including all free public infirmaries, dispensaries, hospitals, and a large part of the vast amount of private charity. What I mean is that the whole of these charities nourish in the poorest classes a contented sense of dependence on the richer classes for those ordinary requirements of life which they ought to be led to provide for themselves.” Perhaps it would brace us and strengthen us if we could feel again those astringent sentiments, and face that vigorous East wind, believing so firmly in the future as to make almost anything tolerable in the present.

* Reprinted in *Methods of Social Reform*, p. 99.

† Reprinted in *Methods of Social Reform*.

For the feeling behind this Victorian hardness was grand. "We cannot be supposed," Jevons concludes, "yet to have reached a point at which the public or private charity of one class towards another can be dispensed with, but I do think we ought to look towards such a state of things. True progress will tend to render every class self-reliant and independent."

Nevertheless, considerations of expediency influenced Jevons, as time went on, to move just a little to the Left, though never to nearly the extent that Mill had moved before the end of his life. He had always advocated a large public expenditure on education (for this, unlike medical attention apparently, would improve the "characters" of the poor), and on the right kind of museums.* His essay on "Amusements of the People"† follows Aristotle in thinking it a public duty to provide good music for universal consumption. The Hallé orchestra, which he attributed to the presence there of "a large resident, well-cultured German middle-class population," was for him the best thing in Manchester. In the London of his day, he writes, "one craves sometimes the stirring clang of the trombones, the roll of the drums, the solemn boom of the diapason, and the exciting crescendo of a great orchestra." It is evident that, whatever Jevons felt about the hospitals, he would have acclaimed the B.B.C. He became, moreover, exceedingly interested in State Trading, as exemplified in the Post Office, and wrote more than once concerning the criteria of policy towards the parcels traffic and telegrams. The last book published in his lifetime, *The State in Relation to Labour* (1882), takes up a cautious, intermediate position. "The all-important point," he explains in the preface, "is to explain if possible why, in general, we uphold the rule of *laissez-faire*, and yet in large classes of cases invoke the interference of local or central authorities. . . . The outcome of the inquiry is that we can lay down no hard-and-fast rules, but must treat every case in detail upon its merits."

It may be interesting to put on record the circulation up to the present time of Jevons's publications,‡ apart from the popular text-books already mentioned:—

Pure Logic (1863), 1,000.

The Coal Question (1865), 2,000.

The Theory of Political Economy (1871), 7,000.

The Principles of Science (1874), 9,000.

Studies in Deductive Logic (1880), 6,000.

* His essay on *The Use and Abuse of Museums*, reprinted in *Methods of Social Reform*, deserves to be read to-day.

† Reprinted in *Methods of Social Reform*.

‡ Kindly supplied to me by Messrs. Macmillan.

The State in Relation to Labour (1882), 9,000.

Methods of Social Reform (1883), 2,000.

Investigations in Currency and Finance (1881), 2,000.

Principles of Economics (1905), 1,000.*

Of the outward facts of his life there is little more to record. In 1876 he succeeded to the Professorship of Political Economy at University College, London.† He took a house high up in Hampstead at the edge of the heath. In 1880 increasing uncertainty of health and a great preference for writing rather than lecturing caused him to resign his professorship. He planned to spend three or four years in Switzerland completing his projected *Principles of Economics*, of which a fragment was published posthumously in 1905. On a Sunday morning, August 13, 1882, he was overcome by faintness while bathing off Gallely Hill, between Bexhill and Hastings, and was drowned. He left three children, a son and two daughters. His son, Herbert Stanley Jevons, was, like his father, educated in science—in his case geology and chemistry—but found his way by natural bent to economics, and has successively occupied the chairs of economics at Cardiff, Allahabad and Rangoon. Jevons's wife survived him nearly thirty years until 1910.

Although Jevons died, greatly lamented by his own world, at the early age of forty-six, I think that his work was done. It was in the decade of his youth from 1857 to 1865 that he had genius and divine intuition and a burning sense of vocation. His flame was paler and less steady at the close.

VII.

What sort of man was Jevons in himself? There is no strong personal impression of him which has been recorded, and 54 years after his death it is not easy to find a definite imprint on the minds of the few now left who knew him. My belief is that Jevons did not make a strong impression on his companions at any period of his life. He was, in modern language, strongly introverted. He worked best alone with flashes of inner light. He was repelled, as much as he was attracted, by contact with the outside world. He had from his boyhood unbounded belief in his own powers; but he desired

* The last three of these were published posthumously.

† Miss Collet writes to me: "It was (I believe) through Mill's own views that Political Economy was never even an optional subject in the University examinations until after graduation in Arts or Science. From 1835 (when McCulloch retired) to 1853, when Jacob Waley began to lecture, the subject was dropped at University College. Waley lectured until 1866, when Cairnes succeeded him [until 1872; then Leonard Courtney 1872-1875; Jevons 1875-1880; Foxwell 1881-1928]."

greatly to influence others whilst being himself uninfluenced by them. He was deeply affectionate towards the members of his family, but not intimate with them or with anyone. When he was 27, he wrote the following about his own state of mind at the age of 16 :—

It was during the year 1851, while living almost unhappily among thoughtless, if not bad companions, in Gower Street—a gloomy house on which I now look with dread—it was then, and when I had got a quiet hour in my small bedroom at the top of the house, that I began to think that I could and ought to do more than others. . . . My reserve was so perfect that I suppose no one had the slightest comprehension of my motives or ends. My father probably knew me but little. I never had any confidential conversation with him. At school and college the success in the classes was the only indication of my powers. All else that I intended or did was within or carefully hidden. The reserved character, as I have often thought, is not pleasant or overly. But is it not necessary to one such as I? *

In Australia he lived almost entirely by himself, and was reluctant to join in the social events of colonial life. In 1857, when he was 22, he wrote home to his sister the following analysis of his own powers :—

I have scarcely a spark of imagination and no spark of wit. I have but a poor memory, and consequently can retain only a small portion of learning at any one time, which great numbers of other persons possess. But I am not so much a storehouse of goods as I am a machine for making those goods. Give me a few facts or materials, and I can work them up into a smoothly-arranged and finished fabric of theory, or can turn them out in a shape which is something new. My mind is of the most regular structure, and I have such a strong disposition to classify things as is sometimes almost painful. I also think that if in anything I have a chance of acquiring the power, it is that I have some *originality*, and can strike out new things. This consists not so much in quickness of forming new thoughts or opinions, but in seizing upon one or two of them and developing them into something symmetrical. It is like a kaleidoscope; just put a bent pin in, or any little bit of rubbish, and a perfectly new and symmetrical pattern will be produced.†

In 1865, not long before he married, he wrote in his Journal :—

At intervals success rewards me deliciously, but at other times it seems but to oppress me with a burden of duty. More and more I feel a lifelong work defined beforehand for me, and its avoidance impossible. Come what will, I cannot but feel that I have faculties which are to be cultivated and developed at any risk. To misuse or neglect them would be treason of the deepest kind. And yet the troubles are not slight which such a high and difficult work brings upon me. One duty, too, seems to clash with others. My idea seems to involve contradictions. I would be loved and loving. But the very studies I have to cultivate absorb my thoughts so that I hardly feel able to be what I would in other ways. And, above all, poverty is sure to be my lot. I cannot aid others as I would wish. Nor in a money-making and loving world is it easy to endure the sense of meanness and want which poverty brings. And if I could endure all this myself, I could not expect nor

* *Letters and Journal*, pp. 12, 13 (see also p. 85).

† *Letters and Journal*, p. 96.

hardly wish for a wife nor any relative to endure it. Half my feelings and affections, then, must be stifled and disappointed.*

After his marriage (his wife had private means) his disposition was not radically changed. He went out very little. He had only a few intimates. Music, which was almost a necessity of life to him,† bathing and solitary walks were his favourite relaxations at all times. He was not an easy man to live with, a little irritable towards the interruptions of family life, excessively sensitive to noise, liable to depression and valetudinarianism, without much conversation. But it is recorded that "his hearty laugh was something unique in itself and made everyone the happier who heard it."‡ From an early age he was liable to attacks of liverishness and dyspepsia and constipation, which latterly became so acute as to overshadow everything and interrupt his work, suggesting perhaps some deeper cause.

He was a reluctant and unsuccessful lecturer. "Somotimes I have enjoyed lecturing," he wrote on his retirement from University College, "especially on logic, but for years past I have never entered the lecture room without a feeling probably like that of going to the pillory."§ The value of his lectures was impaired by his resolution seldom to introduce any of his own ideas but to retail mainly the purest milk of Mill, which he believed to be poison. He never, so far as I know, bred up a worthy pupil; though he was in close touch, at the end of his life, with his two younger contemporaries, Foxwell and Edgeworth.|| Almost every Sunday when he was in London, Foxwell would call on him in Hampstead for a long walk on the Heath; and Edgeworth, who lived close by, was his frequent companion. When I talked of Jevons the other day to Professor Foxwell, recalling these days, "he did not talk much," he said, "there never was a worse lecturer, the men would not go to his classes, he worked in flashes and could not finish anything thoroughly," and then after a pause with a different sort of expression, "the only point about Jevons was that he was a genius."

A photograph of him in later life, which is prefixed to the *Letters*

* *Letters and Journal*, pp. 213-14. † *Op. cit.*, p. 451. § *Op. cit.*, p. 421.

† Jevons was an enthusiastic concert-goer who never missed a chance of hearing classical music, an early Wagnerite, an admirer of Berlioz. He had a small organ built into his house at Hampstead.

|| Also (Miss Collet adds) with Philip Wicksteed. Jevons may have played a significant part in drawing both Wicksteed and Edgeworth to economics. Both had been educated in classics. Edgeworth began his academic work by lecturing on English Language and Literature at Bedford College and on Logic at King's College, and I have no evidence that his interest in economics antedated his contact with Jevons. Wicksteed, Edgeworth and Foxwell may be considered Jevons's offspring, but his contact with all three came some time after they had taken their degrees. The memoir of Jevons in Palgrave's *Dictionary* is by Wicksteed, *q.v.* for W.'s impression of his conversation.

and *Journal*, is familiar. With crinkly beard, curling hair, a broad brow and square face, full nostrils and a full, somewhat protruding lower lip his countenance was almost, one might say, of a Jewish cast, as Professor Foxwell confirms, explicable, doubtless, by his partly Welsh descent, *Jevons* being a variant of *Evans*. His complexion was florid, his hair a darkish brown, and his eyes bluish-grey. It is a powerful, but not a brilliant face. He would pass for a Victorian banker of high standing. There is also a photograph of him (reproduced, facing p. 516), when he was 22 or 23 years old. This is much more interesting, exceedingly strong, keener, clearer, clean-shaven, with a straight lean nose, fine eyes and look, and a tangle of dark unbrushed hair standing back from a high, wide forehead,—a genius then and not at all a banker. These two photographs confirm one's impression that the greatness of Jevons was in his youth.

I have frequently quoted from his *Journal*, which he kept from 1852, when he was 17, up to the time of his marriage at the end of 1867.* This *Journal* is of the highest interest both in itself and for the light which it casts on his nature. I wish I could have had access to the complete text and had not been limited to the extracts published by his wife in her selection of *Letters and Journal*. The volumes are believed to be extant in the possession of his children, but their present whereabouts is uncertain and they are not accessible. This *Journal* received all his confidences and the fruits of his introspection, of his excessive introspection. The *Journal* often, as we have seen, records depression but also the delight of a creative mind in moments of illumination. In March 1866, for example, he writes: "As I awoke in the morning, the sun was shining brightly into my room. There was a consciousness on my mind that I was the discoverer of the true logic of the future. For a few minutes I felt a delight such as one can seldom hope to feel." But he quickly adds: "I remembered only too soon how unworthy and weak an instrument I was for accomplishing so great a work, and how hardly could I expect to do it."†

DISCUSSION ON MR. KEYNES'S PAPER

MR. H. S. JEVONS: I have great pleasure in rising to thank Mr. Keynes for his most interesting and, to me, very personal paper. I was most pleased when several months ago I heard who was to give this paper on the centenary of my father's birth. I felt that no one could have been chosen who was better fitted and more likely

* At least, there are no extracts from it in the *Letters and Journal* after this date.

† *Letters and Journal*, p. 219.

to give a complete and fair review of his life and work. Mr. Keynes is not only familiar with all aspects of statistics and economic theory, but also, by contact with his father, knows a great deal about logic.

Mr. Keynes has referred to the many-sidedness which is an essential attribute of an economist, and I certainly think that, on reviewing the work in the various subjects to which my father contributed some advancement of knowledge, we may say that he had that essential variety of equipment. He began in natural science and he devoted himself with tremendous energy to daily meteorological observations in Sydney; he carried on these observations continuously for two years. He was the only person in the State of New South Wales conducting meteorological observations, and so these observations have gone down in history and will remain as part of the permanent record of the climate of New South Wales. He also wrote much on this subject; as, for example, his paper on "The Deficiency of Rain in an Elevated Rain Gauge."

In his papers on Statistics, with which Mr. Keynes has dealt, he introduced new methods of permanent value; and in his writings on economic theory and logic he followed the methods of precision of conception and definition with which he was familiar in natural science. I might also refer to his invention of a logic machine in which the influence is mechanically performed. Two examples were made, one of which is to be seen in the museum of scientific instruments attached to the Bodleian Library at Oxford.

My father was also interested in the social applications of economics, the first definite indication of that being his "Social Survey of Sydney" carried out probably in his last year there. That has never been published in this country, but a summary of it was published in Australia in recent years. Unfortunately the map of the survey was lost, and I have never seen it. Then there are his articles on social reform, many of which were printed in *Methods of Social Reform*.

The Coal Question comes amongst the economic books; and personally I think the most interesting and far-seeing of the chapters of that book is that on the "Trading Bodies," in which he tries to develop the first effects of the rising cost of coal. There is a paragraph in which he refers to the effect of the Morrill tariff then recently imposed in America, and to the growing tendency of nations toward fiscal protection and self-sufficiency. He foresees a bad period for England in the future if that tendency develops whilst we have to contend with the continual deepening of the coal mines and consequent high price of coal and difficulty in competing with foreign manufactures. Then he goes on to say after that forecast that he cannot believe that people will not be wiser than to build up these closed economic systems.

Mr. Keynes has dealt most fairly with the question of the indebtedness of Marshall to my father, and vice versa. I think it is interesting to speculate what would have been their relations if my father's life had lasted much longer, and he had been able to read the *Principles*. Surely that would have brought them together, and the effect upon each of them might have been great.

If I might say so, I think there was one observation made by Mr. Keynes which I could not altogether endorse. He spoke of the similarity of approach by Marshall and Jevons; but to my mind there is no similarity of approach. Personally I regard the mathematical treatment of economics as the application of a particular method. True, in this respect their methods were similar; but if you look at the fundamental assumptions and the real basis of treatment, I think they are quite different. My father's approach might be said to be derived from Bentham, the founder of the psychological economic school to which he essentially belonged. Extensive quotations from Bentham are to be found in the *The Theory of Political Economy*.

My father also acknowledged a great debt to Senior. This psychological school was carried on by various writers in this country, and developed by the Austrian school; and it appears to me to be a perfectly distinct school of thought from the Mill-Marshall school.

Just a word about the connection of trade fluctuations with solar variations. That, of course, is a most difficult and controversial subject even at present; but personally I cannot help feeling that if people should discuss my father's work a hundred years hence, they might well think that this was one of the most remarkable discoveries or suggestions that he made. The more I have studied this particular subject, the more do I come to believe that there is a very close dependence of many human affairs upon fluctuations of solar radiation, and that that fluctuation is not a definite cyclical variation. Anyone familiar with the literature of the natural sciences in recent years will be struck by the extraordinary number of biologists, botanists and agriculturists who are studying these cyclical variations; as, for instance, in the distribution of animals and plants over the earth's surface, which of course is dependent upon the fluctuations of climate. The results of these researches are being connected up with certain variations which meteorologists have been able to trace, and which are particularly evident in certain parts of the world; and these are being traced back to fluctuations in the sun's radiation.

In the last few months we have had the very striking discovery that short-wave wireless transmission is greatly affected by solar radiation, varying in tune with the sun-spots. Owing to its great practical importance, one hopes that this subject is now going to be thoroughly investigated.

I must take no longer time, but I may observe that Mr. Keynes has not mentioned my father's political activities, which, it is true, were very narrow; but they are rather interesting as indicating his point of view. It appears to have been solely in Manchester that he took any particular interest in politics. There he started a debating Society, the minute book of which I came across some time ago. The Society consisted mainly of members of the staff of the College, and a few students, and lasted only one session or a little longer; but shortly afterwards my father got up a petition which I still have, and which it was intended to present to the Prime Minister, protesting against the title of "Empress of India" having been conferred upon

Queen Victoria. He obtained six signatures of members of the staff of the College; not being able to get more, the matter dropped.

I should like to say again how much I have enjoyed listening to Mr. Keynes's paper in his well-known graceful and easy style, and I have much pleasure in proposing a hearty vote of thanks to him.

DR. BONAR: We have two distinct advantages to-day when we are celebrating here the centenary of the birth of William Stanley Jevons. First, the presence of our friend Professor Jevons, son of the great Jevons, and himself a man of no mean reputation. Secondly, we have Mr. Keynes to speak to us. To take a phrase of Carlyle's, if we were to "riddle creation" I do not know that a better qualified man could be found. You may judge for yourselves, could you have the case better put to you than it has been put to-night? I cannot fancy it very easily. Mr. Keynes has an affinity with Jevons; he is not only an economist but he is a statistician, and moreover he has a large versatility which approaches that of Jevons. I know a little of the extent of Mr. Keynes' versatility, but I do not know whether it extends like that of Jevons to meteorology; quite possibly it does.

It was a little sad perhaps to find the critical element figure so very largely in Mr. Keynes's review. Yet we should not have welcomed a biography that only picked out excellences and left out blemishes; and we have had a pretty frank account from Keynes of Jevons's various attempts, in which he sometimes succeeded and sometimes failed, but which on the whole hardly ever brought him to the top of the mountains he was climbing. On the whole we are left with a slight impression of failure. But it is the failure of a pioneer who does not succeed in persuading all those he is trying to persuade, but will in the end persuade very many.

I am impressed with the risk we run, which was pointed out by Professor Jevons just now, of fancying that Jevons's work had been completed, and was not cut short by his death. Mr. Keynes takes the view that we really had had the best of Jevons, and need not complain; but, when you think of it, forty-six or forty-seven is a very early age for a man like him to end his career. It makes me think of the saying in the "Wisdom of Solomon" which I hope I shall quote correctly: "He being made perfect in a short time, fulfilled a long time."* That, freely interpreted, applies to Jevons; his work goes on though the man ceases to live on this earth.

Some "higher critics" say "He left no perfect work. Why speak of perfection in his case?" They say, many of them, with far less discrimination than Mr. Keynes has used, that Jevons always attempted what he could not quite succeed in doing, and that he was a man of parts—parts which he could not put together into a whole. How many men have done more?

I am more vexed by his policy in college lectures. Jevons, in lecturing at Owens College, well knowing of the great desire of the authorities that the men should pass their examinations, took care that they should, by expounding to them John Stuart Mill. If he

* Which the Great Queen chose for the epitaph on her Prince Consort in 1861.

had expounded his own views instead, they might all have been "ploughed." Was he justified in that or not? I leave that to casuists to decide.

As to Mill himself, I want to tell you a little incident in connection with our own Society. It once occurred to me that John Stuart Mill must have attended meetings of this Society. The Staff were good enough to humour me by making a search in the records to find out if John Stuart Mill had ever sought Fellowship.

No trace could be found of his ever having even tried to become a member; and, if it were ever a question which of the two deserved commemoration more, I vote for Jevons against John Stuart Mill!

I heartily support the motion of thanks to Mr. Keynes for a paper worthy of himself, his subject, and the Society.

SIR WILLIAM BEVERIDGE said he would like to deal with three points arising out of the paper. First of all, he thought he was expected to say something about sun-spots. As far as he was concerned, he had always held that sun-spots had nothing to do with the trade cycle, with big fluctuations of trade and employment and all the rest that went on in the nineteenth century. In the first thing he had ever written about this subject, twenty-eight years ago, he had pointed out that the trade cycle had had very variable periods, while the sun-spot period had not varied. He was afraid that last part was not quite true; the length assigned by astronomers to the sun-spot period had varied from time to time. He thought, however, that it was true that there was no real evidence of a connection, and no probability of a connection, between the sun-spots and harvests and the main cyclical movements in industrial countries.

When one considered the other point, as to whether fluctuations in solar radiations could have any influence upon terrestrial happenings, which would be in turn reflected in economic statistics, one was on entirely different ground.

It was unreasonable to suppose that the sun, which affected so many other phenomena of the world, had no effect upon the growth of crops. That was the particular point that he, personally, started to investigate, and still felt bound to go on investigating, because it produced a cycle of 15.2 years, which Mr. Yule, when criticizing all other sequences, said he did not see could fail to be real as the statistical argument was so strong. That had led him into price history, but in preparing that history, he had deliberately avoided any further study of weather cycles, so that he might not have anything in his mind to influence him as to what he would like the prices to show.

Sir William thought that in the end Jevons would be proved right, not in suggesting that commercial fluctuations were related to physical phenomena, but in suggesting that economic data could be used to throw light upon physical happenings.

The work of Jevons with which he was most familiar was that on the history of prices; that was a study worth following up, and showed Jevons both as an inductive and a deductive economist—the kind of economist that everyone ought to be. Sir William held a fairly

definite opinion that one did not get anywhere by pure deduction; whether one got anywhere by pure induction, he could not say. The greatness of Jevons was that he combined those two things in such a high degree, and therefore it was to be hoped that he would have a large number of successors in the economists of the future.

Sir William concluded by saying how enormously grateful anybody who listened to anything Mr. Keynes had to say, must always feel, and he joined in the vote of thanks that had been proposed.

MR. R. G. HAWTREY said he would like to join in the tributes paid to Mr. Keynes for giving this excellent and vivid paper—for some purposes more than the equivalent of a two-volume biography.

The side of Jevons that especially interested him was his contribution to economic analysis in *The Theory of Political Economy*. One of Jevons's outstanding characteristics was a capacity for intellectual pleasure, the emotion that animates scientific research and investigation, and is associated with the urge to express oneself and to convey to the world the ideas that have given the emotion. Jevons freely admitted that there were some economists who had anticipated his system of analysis in one way or another. But they had failed to make any impression upon the world, and one of the important characteristics of Jevons was that this urge to express took effect in an unrivalled power of expression. A striking feature of his *Theory of Political Economy* was the great amount of ground covered in a most convincing and brilliant way, in a relatively short space, so that it remained in the mind. That faculty which he displayed in it, and which established those ideas as an essential part of political economy ever afterwards, was comparable to the genius of leadership in practical affairs, the quality which enabled a man to gather together his contemporaries to concentrate upon an object. Leadership was the characteristic of great statesmen and great generals, and this analogous faculty of bringing ideas home and giving them a momentum in the minds of other people was one of the characteristics of the great scientists. That was why Jevons need not fear counter-claims of originality in his ideas in this field; it was he who really introduced the ideas into economics. There were contemporaries as well as predecessors who played a great part in introducing the ideas—Marshall, for example—but, to Mr. Hawtreys mind, Jevons had that faculty in a more concentrated form than Marshall. Marshall was addressing, in a way, a narrower field than Jevons, and introducing less energy into the establishment of this tradition of ideas. The same energy and power of exposition to support ideas could be traced in the numerous other fields to which Jevons contributed, his work had remained in the public mind, even in that of people who did not accept his conclusions, but who maintained their interest in what he said. All his ideas remained alive in a remarkable degree.

Mr. Hawtreys said he would like to add one fact which had escaped mention. Jevons entered the Manchester Statistical Society before entering the Royal Statistical Society; he contributed to the Manchester Society at an earlier time, and was its President before

he came to live in London. He therefore came to the Royal Statistical Society with an established position as a leading statistician.

PROFESSOR GREENWOOD said that as time was passing he must put the vote to the meeting, but before doing so he would first give the usual ritual warning to Mr. Keynes that it was not necessary for him to reply to any criticisms, as he would have ample space in the *Journal*; he felt he was only expressing the feeling of every one present when he said that if Mr. Keynes had doubled the length of his paper they would all have been delighted, because its charm had appealed to every one of them.

Mr. Keynes's psychological study had particularly interested him. One small point he would take first. The unconscious antipathy of Marshall for Jevons in early years might perhaps be motivated by the unconscious scorn of the professional for the amateur. Marshall was a very young man; he could not but have been aware that his mathematical training was wider than that of Jevons, and he might well have detected, or thought he detected, some lack of elegance or expertness in Jevons's use of mathematical technique. Perhaps that was what he meant by the reference to David in the armour of Saul.

A much wider question was of Jevons's temperament. That he was introverted was true, but vague. Perhaps Jevons never became on the conative side fully adult. A failure of emotional development to keep pace with intellectual growth was perhaps typical of some forms of genius. The complete balance of a Goethe was rare even within the class of what all would describe as that of genius. Another hero of this Society, William Farr, retained into late life a lack of practical common sense in some directions which was remarkable. Jevons's moments of intense exaltation and his refusal to teach his own students what he himself regarded as truths of the greatest importance, were suggestive. It was not easy to believe that an emotionally adult man with considerable experience of teaching and examining, could really have thought that teaching his pupils what he believed to be the truth would prejudice them in their undergraduate examinations. But the child or adolescent who, finding that others did not share his enthusiasm for something, withdrew into himself, was a very common type. Perhaps Mr. Keynes might consider this diagnosis.

The motion was that a hearty vote of thanks be accorded to Mr. Keynes for his paper.

MR. J. M. KEYNES, in reply, said: I am very much obliged for the interest you have shown in my paper. It has been a special pleasure to read it in the presence of Jevons's son and of his granddaughter, who is also, I am told, an economist.

It may be a rash thing to say that Jevons's work was done; I may very likely be wrong. Certainly what he was doing at the end of his life was good and interesting. But I have lately gone through the experience of reading nearly all Jevons wrote more or less in the order in which he wrote it, and the strong impression left on my

mind is that, while his later work is very good and interesting, it is not the work of brilliant genius that his early work is. There is a brilliance about his early work which surpasses almost anything in economic literature. I am much interested in Professor Greenwood's suggestion as to his emotional immaturity, but I cannot find much corroboration of that in other directions. I would say that he was of the introspective type that is inclined to nurse a grievance rather than get rid of it. He did not get rid of his grievance by breaking out and teaching his own thoughts; he nursed it, which is a quality of the introspective mind. The suggestion that a part of Marshall's feeling was that of the professional towards the amateur may be true.

[Since the paper was read Mr. Keynes has added some particulars about the teaching of economics at University College on the basis of information supplied to him by Miss Clara Collet.]

As a result of the ballot taken during the meeting the candidates named below were elected Fellows of the Society :—

Richard Kenneth Auten.

Lajpat Rai Dawar, M.A.

Harold Wilham George Gearing.

Y. D. Keskar.

Duncan William Mackintosh.

Raphael Lawrence Tiruchelvam.

MISCELLANEA.

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REPLY FROM THE MINISTER OF LABOUR TO THE MEMORIAL ON
EARNINGS AND COST OF LIVING ADDRESSED TO HIM BY THE
PRESIDENT AND COUNCIL OF THE ROYAL STATISTICAL
SOCIETY *

MINISTRY OF LABOUR,
Montagu House,
Whitehall, S.W.1.

SIR,

I am directed by the Minister of Labour to refer to your letter of 5th February, enclosing a Memorial by the President and Council of the Royal Statistical Society, with which the President and Council of the Manchester Statistical Society were associated, making representations as to the inadequacy of the existing statistics of earnings and cost-of-living in the United Kingdom and urging that special enquiries on these subjects should be instituted.

On the subject of statistics of earnings, I am to state that enquiries are at present being undertaken by this Department with a view to obtaining information as to earnings and hours of labour in 1935 in all the industries covered by the Census of Production, with the exception of coal mining and railway service, for which regular returns of earnings are obtained by the Mines Department and the Ministry of Transport, respectively. The data collected in the course of these enquiries, the nature of which is shown in the accompanying copies of the schedules issued, are more detailed than those obtained in any previous general enquiry since 1906. They do not provide a basis for the compilation of statistics on certain points to which special reference is made in the Memorial prepared by your Council (*e.g.*, the numbers of workers in different earnings groups, and earnings in particular occupations), and some of the non-manufacturing industries and services will not be covered by the enquiries. On these points, however, I am to say that the Minister will give further consideration to the representations contained in the Memorial when the enquiries now in progress have been completed.

* Printed in the *Journal*, Part II, 1936, p. 360.

As regards the suggestion that regular enquiries into earnings, in substantially the same form as that which was made by the Board of Trade in 1906, but on a compulsory basis, should be instituted as soon as possible and should be regularly repeated, I am to say that, as your Council will appreciate, this Department has at present no statutory powers under which employers can be required to furnish returns giving particulars of the earnings of workpeople in their employment. While the Minister fully recognizes the value of the information which was obtained by means of the enquiry undertaken by the Board of Trade in 1906, he doubts whether there is at present such a wide measure of agreement as to the necessity for compulsory powers as would be required to justify legislation with a view to securing from employers generally, at regular intervals, returns on the lines of those obtained by that enquiry. Of the employers to whom Schedules have been issued in connection with the enquiries which have been made by the Department in recent years, a high proportion have supplied the information asked for, and the Minister is inclined to the view that, in any extension of these enquiries which may be considered necessary in order to obtain information as to the distribution of individual earnings or as to earnings in particular occupations, the aim of the Department should be to secure, if possible, the voluntary co-operation of the employers concerned.

On the question of statistics of cost-of-living, I am to enclose a copy of announcements made by the Minister in reply to Questions in the House of Commons on April 7th and May 28th, from which your Council will see that he has decided to institute an enquiry into the present-day distribution of working-class family expenditure in order to provide the material required for a revision of the basis of the official cost-of-living index number, and that a Committee has been appointed to advise as to the methods to be adopted in the conduct of this enquiry. It will be observed that the constitution of this Advisory Committee conforms closely with that suggested in the Memorial presented by your Society.

I am, Sir,

Your obedient Servant.

(signed) T. W. PHILLIPS.

By order of the Council the above letter was acknowledged in the following terms :—

The Secretary, Ministry of Labour.

SIR,

I am instructed by the President and Council of the Royal Statistical Society to acknowledge receipt of Sir Thomas Phillips's

letter of June 8th, in reply to the Memorial addressed to the Ministry of Labour regarding statistics of earnings and cost of living in the United Kingdom.

I am to express the appreciation of the Council of the action recently taken in instituting a fresh enquiry into the distribution of working-class expenditure and to assure the Minister that he can rely on the co-operation of the Society if their assistance should be in any way desired.

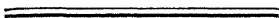
With respect to the subject of statistics of earnings the Council, in view of the assurances given in Sir Thomas's letter, do not, at the present moment, press their suggestion that compulsory powers should be taken for the purpose of obtaining such information. They note with pleasure that, when the present limited enquiry is completed, the Minister will take into consideration the representations contained in the Society's Memorial as to the importance of securing comprehensive statistics of working-class earnings classified according to industry, occupation, and grade of pay. They regard this as a matter of some urgency, and they hope that the Minister will be able to begin such an enquiry at an early date.

I am,

Your obedient servant,

HENRY W. MACROSTY,

Honorary Secretary.



A NOTE ON THE EXISTENCE OF LAGGING CORRELATIONS BETWEEN TWO RANDOM SERIES.

By K. RAGHAVAN NAIR, M.A.

(Research Scholar in Statistics, Madras University.)

1. *Introduction.*

IN the *Journal of the Royal Statistical Society* for 1921 there appears a paper (ref. 1), read before the Society, by Mr. G. Udny Yule, "On the Time-Correlation Problem, with Especial Reference to the Variate-difference Correlation Method." He devotes Section III of his paper (pp. 516-523) to a discussion of "The Differences of a Random Series." Using the notation ${}_k r_{m(m+n)}$ to represent the correlation between Δ_m^k and Δ_{m+n}^k , i.e., between the m^{th} and $(m+n)^{\text{th}}$ terms of the differences of order k , where n is any positive integer ranging from 1 to k (for values of $n > k$, ${}_k r_{m(m+n)} = 0$, as shown in the proof below), Yule works out step by step the correlations for values of k from 1 to 6 (see Table X, p. 250 of ref. 1). Such correlations existing between the terms of the same series Mr. Yule prefers to call by the term "serial correlations" (p. 14, ref. 2). Thus, a random series by definition, can be called a series having all its serial correlations zero, and the k^{th} differences of such a series form another series with its serial correlations represented as

$${}_k r_{m(m+1)}, {}_k r_{m(m+2)}, {}_k r_{m(m+3)} \dots {}_k r_{m(m+k)}$$

Mr. Yule gives their values as

$$-\frac{k}{k+1}, +\frac{k(k-1)}{(k+1)(k+2)}, -\frac{k(k-1)(k-2)}{(k+1)(k+2)(k+3)}, \dots, \\ (-1)^k \cdot \frac{k(k-1) \dots 2 \cdot 1}{(k+1)(k+2) \dots (2k)}$$

and adds that he has not obtained a proof of this general result. Dr. Oskar Anderson (ref. 3) seems to have proved these results, as evident from equations (19A) of his paper. But I regret to state that owing to his paper being written in a language unknown to me, the method of proof given by him is quite unintelligible to me, and so I am giving in the next section an independent proof of the general results, based on the same assumptions as Mr. Yule had made with regard to his random series.

2. *Proof of the General Formulæ.*

Mr. Yule supposes his series $U_1, U_2, U_3, \dots, U_N$ to be a random series, in the sense that the r^{th} term U_r is uncorrelated with the

$(r+s)^{\text{th}}$ term U_{r+s} for all values of s (that is to say, the serial correlations are zero), and further supposes that the series is so long as to render the effect of the end terms negligible compared with that of the central portion of the series. I suppose this last assumption to hold good for the first and last k terms at least, where k is the order of the differences, the correlations between whose terms we are going to determine. This assumption is equal to saying that k is small compared with N . Also, for the sake of simplicity, let us suppose the random series to have its mean at zero. In virtue of the above assumptions, the mean of the k^{th} differences will likewise be zero.

Let S_0 be the standard deviation of the original series, S_k the standard deviation of the k^{th} differences.

Now, by a well-known theorem in the Calculus of Finite Differences,

$$\Delta^k U_m = C_0 U_{m+k} - C_1 U_{m+k-1} + C_2 U_{m+k-2} - \dots + (-1)^k C_k \cdot U_m.$$

where C_i stands for the $(r+1)^{\text{th}}$ term in the expansion of the binomial $(1+1)^k$.

Squaring both sides of the above equation and summing for all values of m from 1 to $N-k$,

$$\Sigma (\Delta^k U_m)^2 = C_0^2 \Sigma U_{m+k}^2 + C_1^2 \Sigma U_{m+k-1}^2 + C_2^2 \Sigma U_{m+k-2}^2 + \dots + C_k^2 \Sigma U_m^2.$$

All the remaining terms vanish during the summation because of the factor $\Sigma U_r U_s (r \neq s)$ which occurs in each of them.

In virtue of the assumption that at least k terms at both ends of the series are negligible, we have

$$\begin{aligned} \sum_{m=1}^{N-k} U_{m+k}^2 &= \sum_{m=1}^{N-k} U_{m+k-1}^2 = \sum_{m=1}^{N-k} U_{m+k-2}^2 = \dots = \\ &= \sum_{m=1}^{N-k} U_m^2 = (N-k) S_0^2. \end{aligned}$$

whence follows that

$$(N-k) S_k^2 = (C_0^2 + C_1^2 + C_2^2 + \dots + C_k^2) (N-k) S_0^2.$$

$$\text{But } C_0^2 + C_1^2 + C_2^2 + \dots + C_k^2 =$$

$$\text{Coefficient of } x^k \text{ in } (1+x)^k (x+1)^k$$

$$= \frac{2k}{k!k!}$$

and therefore

$$S_k^2 = \frac{2k}{k!k!} \cdot S_0^2 \dots \dots \dots (1)$$

This result is given by Mr. Yule (p. 517, ref. 1), and has been worked out previously by Dr. O. Anderson (ref. 4).

Next, we shall evaluate $k^r m(m+1)$. For this we have first of all to determine the value of the product-moment

$$\sum_{m=1}^{N-k-1} \Delta^l U_m \cdot \Delta^l U_{m+1}.$$

Now,

$$\begin{aligned} \Delta^l U_m \cdot \Delta^l U_{m+1} = \\ [C_0 U_{m+k} - C_1 U_{m+k-1} + \dots + (-1)^{k-1} C_{k-1} U_{m+1} + (-1)^k C_k U_m] \times \\ [C_0 U_{m+k+1} - C_1 U_{m+k} + \dots + (-1)^{k-1} C_{k-1} U_{m+1} + (-1)^k C_k U_m] \end{aligned}$$

Expanding the right-hand side and summing for all values of m from 1 to $N-k-1$,

$$\begin{aligned} \sum \Delta^l U_m \cdot \Delta^l U_{m+1} = - \\ [C_0 C_1 \sum U_{m+1}^2 + C_1 C_2 \sum U_{m+1}^2 + \dots + C_{k-1} C_k \sum U_{m+1}^2] \end{aligned}$$

all the remaining terms vanishing on account of the factor $\sum U_r U_s (r \neq s)$ which occurs in each of them.

In virtue of the assumption that the end terms, at least k in number at each end, are negligible, we have

$$\sum_{m=1}^{N-k-1} U_{m+1}^2 = \sum_{m=1}^{N-k-1} U_{m+1}^2 = \dots = \sum_{m=1}^{N-k-1} U_{m+1}^2 = (N-k-1) S_0^2$$

Also,

$$\sum_{m=1}^{N-k-1} \Delta^l U_m \Delta^l U_{m+1} = (N-k-1) \cdot r_{m(m+1)} \cdot S_k^2$$

Hence,

$$k^r m(m+1) \cdot S_k^2 = - [C_0 C_1 + C_1 C_2 + \dots + C_{k-1} C_k] S_0^2.$$

Now, the binomial $(1+x)^k$ may be written in either of the ways:

$$\begin{aligned} C_0 + C_1 x + C_2 x^2 + \dots + C_k x^k \\ \text{and} \quad C_k + C_{k-1} x + C_{k-2} x^2 + \dots + C_0 x^k \end{aligned}$$

from which it is easily seen that

$$\begin{aligned} C_0 C_1 + C_1 C_2 + \dots + C_{k-1} C_k = \text{coefficient of } x^{k-1} \text{ in } (1+x)^{2k} \\ \text{and therefore} \quad = 2k C_{k-1} \end{aligned}$$

$$\begin{aligned} k^r m(m+1) &= -2k C_{k-1} \cdot \frac{S_0^2}{S_k^2} = -\frac{2k C_{k-1}}{2k C_k} \\ &= -\frac{k}{k+1} \dots \dots \dots (2) \end{aligned}$$

An exactly similar procedure for the determination of $k r_{m(m+2)}$ will lead us to the equation

$$(N - k - 2) \cdot k r_{m(m+2)} S_k^2 = + [C_0 C_2 + C_1 C_3 + \dots + C_{k-2} C_k] (N - k - 2) S_0^2$$

$$\text{But } C_0 C_2 + C_1 C_3 + \dots + C_{k-2} C_k = \text{coefficient of } x^{k-2} \text{ in } (1+x)^{2k} \\ = 2k C_{k-2}$$

Hence,

$$k r_{m(m+2)} = \frac{2k C_{k-2}}{2k C_k} = + \frac{k(k-1)}{(k+1)(k+2)} \dots \quad (3)$$

From (2) and (3) it is clear that for the general case (i.e., n^{th} serial correlation)

$$k r_{m(m+n)} = (-1)^n \frac{2k C_{k-n}}{2k C_k} = \\ (-1)^n \frac{k(k-1) \dots (k-n+1)}{(k+1)(k+2) \dots (k+n)} \dots \quad (4)$$

It is clear from equation (4) that for $n > k$, $k r_{m(m+n)} = 0$.

3. Lagging Correlations and the Generalized Variate-Difference Correlation Method.

In the discussion that followed Mr. Yule's paper, Dr. R. A. Fisher made some pertinent remarks on the difficulty of applying the variate-difference correlation method when there existed *lagging correlations* between the two series differenced. He says (p. 534, ref. 1): "... the variate difference correlation method assumed that if they had a series with terms x_1, x_2 , etc., and a second series y_1, y_2 , etc., the only correlation between those series was the correlation between corresponding terms, that was to say, between x_1 and y_1 and so on; there were no lagging correlations." In his subsequent mathematical interpretation of the correlation coefficient obtained by correlating differences of the same order of the two series, in terms of the lagging correlations, Dr. Fisher assumes the two series of x 's and y 's to be the ultimate time-free residuals, and hence *random* with respect to time. Using the notation r_l for the correlation between x_m and y_{m+l} and r_{-l} for the correlation between x_{m+l} and y_m so that r_0 denotes the correlation between contemporary values of x and y , Dr. Fisher says: "the correlation between first differences of x and y will be $r_0 - \frac{1}{2}(r_1 + r_{-1})$, that is to say, one-half the second difference of the r series. If they correlated sixth differences, they would get $1/924$ of the 12th differences of the r series." I work out below the general form of the correlation between k^{th} differences in terms of the lagging correlations assumed by Dr. Fisher.

As before, let the two series have their mean values at zero, and

allow all the other assumptions made by Mr. Yule to hold good for both x 's and y 's.

Then,

$$\begin{aligned}\Delta^k x_1 \cdot \Delta^k y_1 &= (C_0 x_{k+1} - C_1 x_k + \dots (-1)^k C_k x_1)(C_0 y_{k+1} - C_1 y_k + \dots (-1)^k C_k y_1) \\ \Delta^k x_2 \cdot \Delta^k y_2 &= (C_0 x_{k+2} - C_1 x_{k+1} + \dots (-1)^k C_k x_2)(C_0 y_{k+2} - C_1 y_{k+1} + \dots (-1)^k C_k y_2) \\ &\text{etc., etc.}\end{aligned}$$

Summing both sides after expansion of the right-hand side

$$\begin{aligned}\Sigma \Delta^k x \cdot \Delta^k y &= (C_0^2 + C_1^2 + \dots + C_k^2) \Sigma x_m y_m - \\ &\quad (C_0 C_1 + C_1 C_2 + \dots)(\Sigma x_m y_{m+1} + \Sigma x_{m+1} y_m) \\ &\quad + (C_0 C_2 + C_1 C_3 + \dots)(\Sigma x_m y_{m+2} + \Sigma x_{m+2} y_m) - \dots \\ &\quad + (-1)^k C_0 C_k (\Sigma x_m y_{m+k} + \Sigma x_{m+k} y_m)\end{aligned}$$

i.e.,

$$\begin{aligned}{}_k r_{1y} \cdot {}_y S_k \cdot {}_x S_k &= (C_0^2 + C_1^2 + \dots + C_k^2) r_0 \cdot {}_x S_0 \cdot {}_y S_0 - \\ &\quad (C_0 C_1 + C_1 C_2 + \dots)(r_1 + r_1) {}_x S_0 {}_y S_0 \\ &\quad + (C_0 C_2 + C_1 C_3 + \dots)(r_2 + r_2) {}_x S_0 {}_y S_0 - \dots + \\ &\quad (-1)^k (C_0 C_k (r_k + r_k) \cdot {}_x S_0 {}_y S_0)\end{aligned}$$

where ${}_x S_0$ = S.D. of the x 's, ${}_y S_k$ = S.D. of the k^{th} differences of x 's, and similarly ${}_y S_0$, ${}_x S_k$ for the y 's.

Since the x 's and y 's are random series, we have from equation (1)

$$\frac{{}_x S_k^2}{{}_x S_0^2} = \frac{{}_y S_k^2}{{}_y S_0^2} = \frac{|2k|}{|k| |k|}$$

We therefore get

$$\begin{aligned}{}_k r_{1y} \cdot \frac{|2k|}{|k| \cdot |k|} &= \frac{|2k|}{|k| \cdot |k|} r_0 - \frac{|2k|}{|k| \cdot |k|} (r_1 + r_{-1}) + \\ &\quad \frac{|2k|}{|k| \cdot |k|} (r_2 + r_{-2}) + \dots + (-1)^k (r_k + r_{-k}) \\ &= (-1)^k \cdot \Delta^{2k} (r_{-k}).\end{aligned}$$

$$\text{or } {}_k r_{1y} = (-1)^k \frac{|k| \cdot |k|}{|2k|} \Delta^{2k} (r_{-k}) \quad \dots \quad (5)$$

Equation (5) may be thrown into a slightly different form, in terms of the serial correlations within the k^{th} differences of a random series:

$$\begin{aligned}{}_k r_{1y} &= r_0 - \frac{k}{k+1} (r_1 + r_{-1}) + \frac{k(k-1)}{(k+1)(k+2)} (r_2 + r_{-2}) + \dots + \\ &\quad (-1)^k \cdot \frac{k(k-1) \dots 2 \cdot 1}{(k+1)(k+2) \dots (2k)} (r_k + r_{-k}) \\ &= r_0 + (r_1 + r_{-1}) \cdot {}_k r_{m(m+1)} + (r_2 + r_{-2}) \cdot {}_k r_{m(m+2)} + \dots + \\ &\quad (r_k + r_{-k}) \cdot {}_k r_{m(m+k)} \quad \dots \quad (6)\end{aligned}$$

Dr. Fisher remarks that if the lagging correlations $r_1, r_{-1}, r_2, r_{-2}, \dots, r_k, r_{-k}$ are absolutely evanescent, the correlation we get on correlating k^{th} differences is the true contemporary correlation r_0 . This is clear from equation (6), since all the terms on the right-hand side except the first will vanish in that case. If our hypothesis about the existence of a series of lagging correlations between the two series be true, the effect of differencing is easily explained mathematically in equation (6). In such a case, "Student's" generalized method (ref. 5) of getting at the organic correlation independent of spurious time by successive differencing, obviously fails to give us the contemporary correlation r_0 we are seeking.

Let us now examine whether between two *random series* there can exist such a series of lagging correlations as postulated by Dr. Fisher, with a statistically significant value for each. That this cannot be the case is easily seen if we remember that r_0 is itself one of this series of lagging correlations, the time-lag corresponding to it being zero. Generally when we suspect the existence of r_0 between two series we seldom care to look for the presence of other lagging correlations. We proceed on the assumption that r_0 is the only existing correlation. Similarly, it is quite reasonable to assume that r_n , the correlation between x_m and y_{m+n} , is the only existing correlation, and that all the other correlations with different time-lags, including r_0 , are evanescent. I mean that between two random series there can be only one definite time-lag, if any. According to Dr. Fisher, we are assuming that any x is at the same time correlated with $y_1, y_2, y_3, \dots, y_k, \dots$ while the y 's themselves are supposed to form a random series. Of course, between two series which are not random, but possessing serial correlations (most economic and sociological series are of this nature), one may come across significant lagging correlations belonging to different time-lags, and it has been the rule in such cases to take the biggest of the lagging correlations as leading to the most probable or most conspicuous time-lag.

Let us therefore proceed on the assumption which seems most reasonable to me, that there is only one definite time-lag of, say, n periods between x and y , so that r_n is the only true correlation between the two series. Equation (6) will then reduce to

$${}_k r_{1y} = {}_k r_{m(m+n) \cdot 1n} = (-1)^n \frac{k(k-1) \dots (k-n+1)}{(k+1)(k+2) \dots (k+n)} \cdot r_n \quad (7)$$

So the effect of differencing k times is to reduce the existing lagging correlation in the ratio $1 : k \cdot n(m+n)$ (n supposed to be less than k). From the known ${}_k r_{2y}$, the true lagging correlation r_n can be

calculated. Difficulties will be encountered in its practical application if the definite time-lag is not known beforehand. But if in any particular case a time-lag is reasonably suspected, even after differencing we can get at the correct value of the lagging correlation, with the aid of equation (7). If $n = 0$ we get ${}_k r_{\cdot y} = r_0$, which is "Student's" result (ref. 5), viz., that the correlation between corresponding k^{th} differences of two random series of x and y is the same as that between the corresponding terms of x and y .

In equation (7) we have obtained ${}_k r_0$, i.e., the correlation between corresponding terms of the k^{th} differences of the two series. Let us find ${}_k r_n$, the lagging correlation between the m^{th} term of the k^{th} differences of the x series and the $(m + n)^{\text{th}}$ term of the k^{th} differences of the y series.

To evaluate this we have

$$\Delta^k x_m \cdot \Delta^k y_{m+n} = (C_0 x_{m+k} - C_1 x_{m+k-1} + \dots + (-1)^k C_k \cdot x_m) (C_0 y_{m+n+k} - C_1 y_{m+n+k-1} + \dots + (-1)^k C_k \cdot y_{m+n})$$

and

$$\Sigma \Delta^k x_m \cdot \Delta^k y_{m+n} = (C_0^2 + C_1^2 + \dots + C_k^2) \Sigma x_m \cdot y_{m+n}$$

all other terms vanishing, since r_n is supposed to be the only existing correlation between the original series of x and y .

Hence

$${}_k r_n \cdot {}_k S_k \cdot {}_y S_k = \frac{|2k}{[k] \cdot [k]} r_n \cdot {}_x S_0 \cdot {}_y S_0$$

or

$${}_k r_n = r_n \quad \dots \quad (8)$$

Therefore, the lagging correlation corresponding to a time-lag of n periods between the k^{th} differences of two random series of x and y is the same as the lagging correlation between the original series corresponding to a time-lag of the same period, provided of course the latter is the only existing lagging correlation between the two series.

We find that there are a series of lagging correlations between the k^{th} differences of the two random series (owing to the differences possessing serial correlations, as shown in section 2), of which ${}_k r_0$ and ${}_k r_n$ have been determined in equations (7) and (8) respectively. Others can be calculated easily, and the general value is given below :

$${}_k r_{n \pm p} = {}_k r_{m(m+p)} \cdot r_n; \quad (p = 0, 1, 2, \dots, k) \quad (9)$$

where n is supposed to be less than k .

There are $(2k + 1)$ lagging correlations, of which ${}_k r_n$ is the middlemost as well as the biggest, and the rest decrease symmetrically on either side of it.

Also it must be noted that ${}_k r_n$ being independent of k ,

$${}_k r_n = {}_{k+1} r_n = {}_{k+2} r_n = \dots = r_n.$$

This property can be made use of in determining r_n , the lagging correlation between the time-free residuals, when the given series of x and y involve time, and hence cease to be random. Suppose x and y to be represented by the equations

$$\begin{aligned} x &= X + \phi_1(t) \\ y &= Y + \phi_2(t) \end{aligned}$$

where X and Y are random with respect to time and possess a lagging correlation of period n . Let ϕ_1 and ϕ_2 be each of degree k in t . In that case the k^{th} differences of x and y will consist only of the k^{th} differences of X and Y , so that we get further differencing

$${}_k r_n = {}_{k+1} r_n = {}_{k+2} r_n = \dots = r_n.$$

I have thus endeavoured in this paper to explain the generalized variate-difference method as developed by "Student," for the case when there exists only one lagging correlation between the two series.

These results I dare say are not going to be of much use in practical work. But that difficulty is not peculiar only to the results shown here, as the same assumptions have been made with regard to the random series in previous works on the variate-difference correlation method, and which remain a formidable obstacle to its use in practical work where the series seldom extend beyond a limited sequence of years.

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REVIEWS OF STATISTICAL AND ECONOMIC BOOKS.

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1.—*The Application of Statistical Methods to Industrial Standardization and Quality Control.* By E. S. Pearson, D.Sc. British Standards Institution, 1936. $8\frac{1}{2}'' \times 5\frac{1}{4}''$. 161 pp. 5s.

There must be few statisticians who have not, at one time or another, come up against the difficulty of "getting their ideas across." Statisticians, in dealing with statistical theory, are like chess players. They can be classified into groups of different ability at the game. What is quite obvious to a member of one group may only be apprehended with considerable difficulty by a member of the next lower group. Of course this is not the whole story. There are a few people, with perhaps relatively little knowledge of statistical theory, but with a flair for getting at the meaning of figures. Where this exists, it is invaluable, but even the results of such intuitive processes should be submitted to the test of ordinary statistical reasoning before they obtain general credence.

This "getting of ideas across" has been one of the main difficulties in the way of the spread of modern statistical methods. It has been more easily surmounted, perhaps, in the case of intelligent biologists and technicians with but little knowledge of mathematics, but with an understanding of the meaning of experimental processes, than with some mathematicians who lack the necessary insight and interest, but stick at difficult points of statistical theory. But the

variability in this respect both among biologists and among mathematicians is very great.

However this may be, some years of experience in teaching students with but little knowledge of mathematics and no previous training in statistics has convinced the reviewer that it is impossible to be too elementary in exposition or concrete in the choice of examples. Regarded from this point of view the present work is a *tour de force*.

This book arose out of a conference held in May 1932, at the instance of the British Standards Institution, between representatives of manufacturing industries and others interested in statistical methods and Dr. W. A. Shewhart of the Research Laboratories of the Bell Telephone Company of America, whose pioneer work on the economic control of quality is well known.*

The book opens with a review of its own scope which is really the discussion of the function of statistical methods in helping to secure the conformity to specification of a consignment of raw material or manufactured articles. This may be done either: (a) "by testing units sampled from consignments" or (b) "by requiring that records be kept by the producer which, supplemented by a system of check testing, will provide statistical evidence of the level of control maintained during manufacture." Three examples are then given illustrating the use of statistical methods in control—the tensile strength of malleable iron castings, the breaking strength of cloth, and the ash content of samples of coal. The first serves to show how the producer may detect causes of trouble in his processes, the second how the precise rules for acceptance or rejection are related to the size of samples tested, and the third how the accuracy of an estimate of quality depends on the amount of sampling carried out.

Next we are introduced to the simpler statistical tools, averages and measures of dispersion, frequency distributions and the normal curve. This is followed by discussions of the relation of sampling to statistical theory, of what is meant by statistical control and of how it may be secured either by method (a) or (b) above. Considerations of importance to user and producer are outlined; it is suggested that if the user can be assured that method (b) is properly carried out he may be saved the expense of costly testing by method (a), while method (b) is of advantage to the producer because it involves the same form of statistical analysis as he would employ in attempting to increase the efficiency of his production process.

This is followed by a section on the statistical relationship between sample and batch, which deals with formulæ for the sampling variance of means and standard deviations, the reliability of a mean estimated from a representative sample or from a comparison of duplicate samples. Here we have an illustration of the use of the mean strength and the strength of the weakest strip, in a sample of prescribed size, in specifying the quality of cloth. Finally, this section deals with fiducial or confidence limits for means, standard deviations and

* *The Economic Control of Quality of Manufactured Product*, 1931. See also a review, *J. Roy. Stat. Soc.*, XCV, p. 546, 1932.

coefficients of variation, and a useful table of such limits is given for sizes of sample from 5 to 30.

A further section deals with cases where the mean and standard deviation or the mean and coefficient of variation are simultaneously used for specification purposes, and by means of an admirable diagram the relations are clearly brought out between the nominal specification line, the producers' safety line, which leaves only a small risk of his good material, when tested, failing to be up to the nominal specification (and therefore being rejected), and the users' effective specification line, which leaves only a small risk of faulty material, when tested, being up to nominal specification (and therefore accepted). Finally there is a section, with several good examples, dealing with control charts.

The form of this book is as good as its matter; particularly handy are the folded diagrams at the end of the volume, which may be readily consulted while any page of the book is open and which, quite exceptionally, are made of paper sufficiently strong not to tear or crease the first or second time they are used. J. O. I.

2.—*Tables of the Higher Mathematical Functions*. Vol. II. Computed and compiled under the direction of H. T. Davis, Indiana University, and the Cowles Commission for Research in Economics. Bloomington, Ind.: The Principia Press, 1935. (London: Williams & Norgate). $9\frac{3}{4} \times 6\frac{3}{4}$ " ; xiii + 391 pp. 25s.

The first volume of this work appeared in 1933 and was reviewed in this *Journal* (Vol. XCVIII, Part II, 1935, p. 386).

The functions tabulated are (1) the Trigamma function $\frac{d^2}{dx^2} \log \Gamma(x)$ and its first three derivatives, the Tetragamma, Pentagamma and Hexagamma functions. The tables for the trigamma function are as follows:—

Range of x .	Tabular Interval.	Number of Decimal Places.
-10-0	0.1	10
0-1	0.01	12
1-4	0.01	12
4-20	0.02	10
20-100	0.1	15

Central differences are given. The range and tabular intervals are the same for all three functions. Since

$$\frac{d^2}{dx^2} \log \Gamma(x) = \sum_{r=0}^{\infty} \frac{1}{(x+r)^2}$$

the functions find their chief use in the summation of series containing inverse powers.

(2) Tables of the Bernoulli and Euler polynomials up to the eighth degree from $x=0$ to $x=1$ by 0.01: of the Bernoulli and Euler numbers (in particular the logs. of the first 250 to 10 or 12 decimal places); and a table of the sums to infinity of the inverse powers of the integers, to 32 decimal places up to the power 100.

(3) Tables to facilitate the fitting of a polynomial by least squares to a set of evenly-spaced data. If the polynomial is

$$a_0 + a_1x \dots + a_nx^n$$

the coefficients a_r are linear functions of the moments M_r of the data. The numbers tabulated are the coefficients of the moments in these linear functions, so that the polynomial approximation may be found, without solving any equations, as soon as the moments have been calculated. The tables cover polynomials up to the seventh degree, the range being in all cases at least 50 values.

Each set of tables is prefaced by a short account of the properties of the functions tabulated and of previous tables of the same functions where they exist. The presentation of the tables is very handsome.

In connection with the polynomial approximations, it would be interesting to know: (1) whether there is any quick method of finding the reduction in the sum of squares, as this is often the first thing wanted in such curve-fitting; (2) how the method given compares for speed with the summation method described by Fisher (*Statistical Methods for Research Workers*, § 28). In one respect the data chosen for the example of curve-fitting, though they have figured prominently in the literature, are unfortunate, in that even the seventh-order curve gives two negative approximations to a set of values which are essentially positive.

Three minor errors have been noticed: on p. 202, second line of the example, the second series should start with 2 and not with 1; on p. 314, the coefficient of x^4 in the septic should have a positive and not a negative sign, and on the same page the septic approximation at $x = -7$ should have the value 1.59 and not 0.59.

W. G. C.

3.—*A Point Scale of Performance Tests*. By Grace Arthur. Volume 1. Clinical Manual. New York: The Commonwealth Fund Division of Publications, 1930. London, Mr. Milford, Oxford University Press, 1933. 9½" × 6". ix + 82 pp. 7s. 6d.

The purpose of the work of which this is the first volume is to present to the psychological clinician a numerical scale of intelligence based on non-verbal performance tests. It is designed to supplement the Binet rating of intelligence or to give a rating in cases where the Binet tests, on account of language difficulties, speech or hearing defects, etc., are inadequate.

It is claimed that the non-verbal performance tests used in building this scale have been standardized, so that the clinician may have confidence in the proposed scale as in the Binet scale. There are two measures given: the first, Form I, is for a first testing, and the second, Form II, for a re-test approximately one year later. The age norms for Form I were based upon results obtained from about 1,100 schoolchildren, and the norms for Form II on 535 of the same children. The actual details of standardization are to be given in the second volume.

This first volume gives complete tables for converting raw test scores into "points" on the scale. The summation of the points

gained in the several tests may then be converted into a "mental age," in years and months, by reference to a further table.

The tests themselves are of a sort familiar to all psychologists, being chiefly of the Form Board, Picture Completion or Maze type. Each test is fully described and detailed instructions for giving it to different types of subjects are supplied. Individual clinicians might, however, prefer to use their own technique in testing. Assuming the validity of the standardization, the volume presents a rule-of-thumb method of arriving at the "mental age" of each subject.

A method of extrapolation for finding the mental age of subjects who lie outside the standardized range is described, and also a method of making an allowance for a test which is omitted for any reason.

The validity of the standardization cannot be assessed until the second volume of this work is available, but assuming that the "point scale" is statistically reliable, it should be very useful to psychological clinicians who are interested in the I.Q. of their patients and who are unable to use verbal tests. It is possible to criticize some of the tests used, since they are admittedly of the puzzle type, which increases the chance element of success in their performance and heavily weights subjects with previous acquaintance of the sort of test.

It is also claimed, probably with truth, that these tests and the rating they yield are of value in aiding the understanding of various clinical conditions frequently encountered, both by the rating itself, compared with the Binet rating when possible, and also by the behaviour of the subjects during testing. This latter feature of the method will be held by some psychologists to be of more value than a mere knowledge of a numerical I.Q. E. G. C.

4.—*A Course in Business Statistics*. By Charles H. Bayliss, B.Com. (London). London: Sir Isaac Pitman & Sons, Ltd., 1935. 7½" × 5". 178 pp. 3s. 6d.

This book is written for those who are preparing for examinations in business statistics, and is particularly intended for the examination in the subject recently introduced by the London Chamber of Commerce. For this purpose it can be highly recommended. The ways in which badly prepared or ill-defined figures can mislead the reader are emphasized in the opening chapter, which leads to the consideration of how data should be prepared and of how facts should be statistically presented. Sampling is briefly mentioned, without mathematical treatment but with sufficient clarity to indicate what the process may be expected to yield. The degree of accuracy obtainable from the use of approximate figures is illustrated with well-chosen examples. Arithmetic and moving averages, the median and the mode, are discussed at length. The geometric mean, however, might at least have been given a paragraph. Under the title "Published Index Numbers" reference is made to the Sauerbeck and *Statist*, the *Economist*, and the Ministry of Labour's series; the Board of Trade index is not mentioned, and the doubtful validity of applying the present official index of retail prices to the salaries of Government and municipal workers is not suggested. The

tabulation of data and construction of diagrams are discussed at some length, and remind the reviewer of an instruction he once received, to "make it very simple, it's for a director." Correlation is a difficult subject to present in eleven pages, but sufficient treatment is given to enable the student to follow the arithmetic of the process even though he does not know the reason behind it.

Each chapter concludes with a series of questions on the material discussed, and the answers are given at the end of the book.

The student who conscientiously applies himself to this small book should have no fear of an elementary examination in the subject.

R. F. G.

5.—*Seasonal Variations in Employment*. By Christopher Saunders. With an introduction by G. W. Daniels, M.A., M.Com. London: Longmans, Green & Co. 1936. xii + 311 pp. 15s.

This is a study of seasonal fluctuations in the numbers employed in the insured industries based almost entirely on the statistics published monthly in the Ministry of Labour Gazette, and covering the period 1924–32. The method followed is that of calculating the percentage deviations of the monthly figures from a twelve-month moving average. By this it is claimed that a great part of the cyclical fluctuation is eliminated, as indeed it is, and that the deviations from the moving average represent the seasonal variations. The mean of these monthly deviations gives the "amplitude" of the seasonal variations of each industry. The range of the variations has also been measured by taking the difference between the numbers employed at the seasonal peak and the seasonal trough on the assumption that there is no seasonal unemployment at the highest point of the seasonal curve. Altogether sixty-three of the hundred industries investigated were found to possess appreciable seasonal characteristics, and these included 76.6 per cent. of the total number of insured persons. Among females the proportion was 84 per cent. and among males 74 per cent. In addition, twenty industries covering 12.7 per cent. of insured persons showed some traces of seasonal variation, "but the seasonal swing is irregular, and the pattern of it may alter appreciably from year to year."

It is estimated that the total number of persons who experienced some seasonal unemployment during the year ranged from 600,000 to 860,000 during the period 1924–32, and was highest during the years 1930–32. The proportion varied from 4.8 per cent. to 6.8 per cent. of the insured population. Not all of these, of course, were unemployed at the same time, and the *average* amount of seasonal unemployment during the year fluctuated round about 2 per cent., amounting to 13 per cent. of the total unemployment in 1924 and 1928, and to 11 per cent. in 1932.

The author has taken the mean of the monthly percentage deviations from the moving average as the best index of comparative seasonality, and, judged by this test, the most seasonal industries are, in order, tailoring, linen, cotton, building, coal-mining, pottery, wall-paper, and fishing. It is a little difficult to accept this order as quite accurately recording the intensity of the seasonal character,

especially in the case of the linen and cotton trades. During the period covered by the statistics these two trades (and the cotton trade in particular) have been very seriously affected by depression in other countries, and by export, political and other difficulties causing grave disorganization, and it may well be that these troubles have masked the amounts, and even the pattern, of their seasonality. It would be interesting to know whether such amount and trend are supported to any extent by evidence relating to the period previous to 1914. The trade union statistics of unemployment in the cotton trade were unfortunately confined to the preparing and spinning branches of the industry, but these might be sufficient to show whether the seasonal unemployment then was as pronounced as the post-war figures seem to indicate that it is now.

A long chapter of nearly fifty pages is devoted to a careful and elaborate survey of the fluctuations in production and in employment in the motor-making and allied trades, which are very considerable, and to the discussion of suggestions for evening out employment. The clothing trades, in which the problem of seasonality is perhaps the worst of all, is similarly dealt with, and a further chapter is devoted to the building industry. For the last-named, charts are given showing the proportion of workers employed in each of the principal occupations and, in the case of London and the United Kingdom, in all occupations. One has always been a little sceptical of the peak of employment for London being shown as at the end of August. The claim for such a maximum of employment was first made, we believe, in Mr. Dearle's book on *Problems of Employment in the London Building Trades*, published in 1907, and must have been based on the monthly figures of unemployed members in the joiners' and plumbers' trade unions. Sufficient allowance was probably not made for the fact that many building-trade craftsmen migrate from the provinces to London in the spring with the object of obtaining employment at such a busy period, and with the further object of securing a more or less permanent footing in the metropolis. After the full employment of spring and early summer those then out of work may linger for a week or so in London, but ultimately return to their homes. Such a practice was very prevalent at the commencement of the century and still operates, though not to the same extent, and, as the men would lift their books from the London Exchanges to deposit them afresh in their local exchange, the result would be to lessen the number of unemployed recorded in London. It is difficult, moreover, to imagine that a spurt in repairs and decorations could raise the proportion employed to such an extent as is indicated. An interesting chapter is devoted to agriculture and its quite considerable share of seasonal work, and a final chapter discusses, with excellent reasonableness, the various suggestions for mitigating the severity of the fluctuations in industry. The difficulties and the limited extent of "dovetailing" occupations are evidently fully recognized. The volume concludes with appendices giving the statistics that were compiled for the purposes of this thorough and interesting investigation, a chart showing the seasonal variations in each of the 63 trades, and a bibliography. W. A. B.

6.—*The Downfall of the Gold Standard.* By Gustav Cassel. Oxford: Clarendon Press, 1936. 7½" × 5". viii + 262 pp. 6s.

This book is in part a brief summary of the financial history of the world since the outbreak of the European War, but it is also, and in greater part, a synopsis and defence of the author's views on monetary policy during that period. In both respects it is a useful book, in that it recounts the chief events of a momentous time and in that it displays the evolution of a distinguished economist's opinions. The merit of the gold standard was that it kept the prices of the nations in an organic relation to each other, but its demerit was that any disturbance in the price-level of one nation was communicated to the price-levels of other nations, and in particular to that of the United Kingdom, the pre-eminently trading nation. This disturbance had to be combated by counter-action, and the result was that industrial and mercantile interests were successively exposed to two sets of warring forces, which together did not help business. Professor Cassel rightly indicates various other circumstances which could, and he says did, impede the working of the standard, but unfortunately he does not adduce any statistical proof. The belligerent nations went off gold, but after peace came they set themselves to get back to the old familiar road. "I spent," says Professor Cassel, "many years of hard fighting for the restoration of our international gold standard. But when success seemed within reach, the forces of destruction again set in and swept away everything that had been accomplished. Careful examination of subsequent events has convinced me that a new attempt at restoration would be hopeless."

Professor Cassel holds that the cause of the collapse of 1931–32 was monetary and inherent in the nature of the gold standard, and is somewhat scornful of those who attribute the depression to over-production, wage and price rigidities, trade restrictions, and other economic factors. One would rather say that the gold standard was designed to work only in a world that was substantially free-trade where gold was allowed to work its natural effects on prices. While he justifies, and in the reviewer's opinion rightly, Britain's return to gold in 1925, he is justly severe on the hesitation of the Government and the financial authorities after we were driven off gold for the second time and their unwillingness to declare their policy or to admit that a new monetary objective was necessary. Two leading arguments in favour of gold he rejects. First, that it is needed for settlements of international balances, which is "refuted" by an investigation of events in Sweden which he himself made. Second, that it is required as a regulator of credit, for the present mal-distribution of gold makes such a principle most perilous. He thinks that monetary policy should aim at the stabilization of the internal price-level on the basis of some improved index-number, so as to achieve an equilibrium between costs and prices and between debts and incomes. It may be observed that such an index number is not easy to come by, for wholesale prices are not the only consideration. A virtual stabilization of wholesale prices was achieved in the United States between 1925 and 1929, but the outpouring of credit resulted in soaring prices of securities and real estate until the whole crazy

structure blew up. For practical purposes he advocates a gradual extension of the sterling bloc by the inclusion of other countries as they succeed in stabilizing internal prices—adducing the case of Sweden as an example—and in establishing the relation between different currencies he says that “a calculation of the purchasing-power parities must be a preliminary and very important step,” though other factors are important; what is said above on prices is pertinent. The sum of the whole story is that “for all practical purposes the gold standard is a thing that belongs to the past” and we now have to lay “the foundations of a new and more reliable monetary system.”

H. W. M.

7.—*The Rational of Central Banking*. By Vera C. Smith, B.Sc. (Econ), Ph.D. (London). London: P. S. King, 1936. 9" × 6". xii + 185 pp. 9s.

This is primarily a survey of the arguments that have been brought forward at various times and in various countries in the controversy over the rival merits of a central banking and a free banking system. The existence of a centralized and controlled note issue is so largely taken for granted in these days that it is easy to overlook how much has been written in support of multiple note issues by commercial banks, and it is perhaps salutary to be reminded that the arguments in favour of the latter system have had a wide vogue amongst economists of repute in their day. Anyone interested in banking and currency questions is certain to know something of the history of the Scottish banks of issue, and to be familiar with the arguments developed by Bagehot in *Lombard Street*, but much of the material handled by Miss Smith is considerably less well known, and there will probably be few of her readers who do not find themselves at times wandering on unfamiliar ground.

The first few chapters deal with the development of Central Banking in England, France, Germany, and America. Here Miss Smith is merely considering briefly subjects that have been more fully investigated and described by other writers. It is when she gets on to her real subject, the developments in the discussions on Central Banks in the different countries concerned, that she embarks on her original work, and as a matter of arrangement it is questionable whether she would not have made a more interesting book by omitting the earlier historical chapters and embodying the essential facts in them with these later discussions of theory. The views brought forward at different times would then have been more easily linked up with their proper historical background.

Of the chapters surveying the developments of theory it is certainly those on the European writers that are the most interesting. The chapter on the discussions in America prior to the foundation of the Federal Reserve System again goes back to more familiar ground, and contains little or nothing that is not to be found in the standard works on the inception of the system.

When one turns to the European writers it is surprising how various were the arguments brought forward on either side. In France opinion was at first much influenced by the purely juristic argument that the issue of coinage was a State prerogative, and that

the note issue, therefore, properly belonged to a State-controlled bank. Much emphasis was also laid on the importance of maintaining a low rate of discount, a point of view that has, of course, always been to the fore in France. Aubry, writing in 1864, even took the line that the Bank of France had been given the right of note issue purely for the purpose of keeping discount rates low, and it was therefore improper for it to use the discount rate to control the movement of specie. One startling argument against the existence of a note issue by a Central Bank was that advanced by Cernuschi (1865), who held that any note issue had the effect of spoliating holders of metallic currency by depreciating its value, and that, given a free note issue, notes would gradually disappear, since no one would accept them—but this can hardly be considered as a serious contribution to the controversy.

To a certain extent the demand for free banking was based on a desire for inflationary conditions, but this was by no means true of all its supporters, some of whom maintained, on the other hand, that there was less check on inflation under a Central Bank than there would be under a free system. This, of course, was the essence of the problem, whether a Central Bank or a free banking system would be likely to provide the more stable issue, and, as a corollary to this question, whether the clearing of notes between the various issuing banks under a free multiple system would, or would not, act as a check on excessive issues by individual banks. One interesting contribution to the controversy was that made by Geyer (1867), who held that the existence of an uncovered note issue provided the material for trade crisis by producing "artificial capital" until there was an excessive amount of capital in existence, and then intensified the crisis by a later contraction of credit. This, as Miss Smith points out, is approaching very close to the over-investment theories of the Austrian school.

One aspect of the question not dealt with by Miss Smith is the influence of limitations on the profits allowed to Central Banks. Some legal restriction on the dividends paid exists in the case of every Central Bank, other than the Bank of England, and this inducement to a conservative financial outlook could not have been entirely overlooked by those who maintained that Central Banking was less likely to lead to inflation than free banking.

As to the general style of the book, Miss Smith writes clearly and to the point, and develops her arguments with lucidity; nevertheless there is a certain effect of flatness. She has not the gift of welding her details into a rounded whole or making the more salient features stand out in perspective. Nevertheless, one is grateful for a book which, in spite of certain weaknesses, does contain plenty of interesting and but little known material.

W. A. E.

8.—*British Banks and the London Money Market*. By R. J. Truptil, Ph.D.Econ. (Paris), with a preface by Sir Robert Kindersley. London: Jonathan Cape, 1936. 8" × 5½". 352 pp. 10s. 6d.

M. Truptil's book was originally written in French, and the present excellent translation has been enlarged and brought up to date. It is a lucid and practical exposition of the organization and

functioning of the London money market, and has the advantage of being written by a man who is actually engaged in taking his part in the working of the machine. The book is divided into two parts; the first contains chapters dealing with the origin and present organization of the Bank of England, joint-stock banks, the discount and acceptance houses, and the clearing house; we are glad to see it, includes also a chapter on foreign, colonial and Dominion banks, a part of the City which is often neglected by writers. This section concludes with a review of the City as one whole.

The second part of the book deals mainly with the functioning of the machine, and terminates with a chapter on the future of the City and the Socialist programme for its reform. It contains also an interesting comparison between the London and Paris money markets, of which latter market the author also has practical experience.

M. Truptil's statistical investigations, theoretic balance sheets, and estimates of the amount of acceptances current in the market, are novel and interesting. It is, perhaps, natural that, with the present absence of new foreign issues, considerable more space is devoted to the accepting side of the merchant banker's business than to the issuing side. We are told by the author, in his chapter on the Bank of England, that several of the merchant bankers "appear to have won a dynastic right to be represented on the Court," and in the case of two or three houses M. Truptil shows that during long periods representatives of these houses have been Directors of the Bank. The existence of this dynastic right has been so often alleged that it is desirable that the vehement denial made by Sir Ernest Musgrave Harvey before the Macmillan Committee should at least be mentioned.

It may be anticipated that it will not be long before a second edition of this book appears, and M. Truptil may take the opportunity of correcting a somewhat misleading error on p. 159, where, while the figures for merchant bankers' foreign acceptances are correctly taken from the Macmillan Committee Report, those for 1929 and 1930 inadvertently include "English Acceptances." The figures are given correctly on the next page, and these form the basis for the estimates made by the author for the succeeding four years.

M. Truptil may also perhaps qualify the statement which he makes on p. 44 that the Government Debt of £11,015,000 "is the Funded Debt." In the general sense in which the term is used, it would be more accurate to say that it is *part* of the Funded Debt.

These two quite minor points do not detract in any degree from the reviewer's appreciation of the excellent way in which M. Truptil has performed his task and produced a book which every student of the subject must have on his shelves.

B. E.

9.—*The Theory of Monetary Policy*, with special reference to the relation between Interest Rates and Prices. By B. P. Adarkar, Professor of Economics at the Benares Hindu University. London: King, 1935. 8 $\frac{3}{4}$ " \times 5 $\frac{1}{2}$ ". xi + 127 pp. 7s. 6d.

Economists distinguish between primary and secondary products, and we may similarly draw a line between men who invent new

theories and those who criticize them. Professor Adarkar belongs to the latter category, and the first part of his book is occupied with an acute commentary on the "conceptual" rates of interest discovered or invented by Irving Fisher, Cassel, Wicksell, Hayek, Sraffa, and Keynes. Those who carry in their minds the details of those theories will find it beneficial to tackle Professor Adarkar's criticisms, but for others it will be necessary to have the incriminated books open beside them, for the critic's references are sometimes of an allusive nature. Böhm-Bawerk and Hawtrey also come under correction, but D. H. Robertson's wit secures him honourable quotation. The real hero of the book is J. M. Keynes, the penultimate Keynes of the *Treatise on Money*, who "has given a new vision and a new methodology of approach towards the difficult problems of monetary science," and from whom Professor Adarkar only "takes the liberty of differing in places" with some trepidation. Everyone will agree, in general terms, with the praise, but one is curious to know how the hero of the *Treatise* is to be reconciled with the ultimate Keynes of *The General Theory of Employment, Interest, and Money*, an important work which seems, so far, to have produced as much heat as light. Luckily for him, Professor Adarkar wrote before the publication of the later book.

This is not the place to try either to find one's way through the successive jungles of monetary theory or to attempt to clear them away. Professor Adarkar's book is mainly condemnatory comments on the nature of the vegetation—with due exception of the Keynesian jungle—and his own conclusion is that he has "had little to offer by way of a contribution to the solution of current problems of monetary control." Theory failing, we plainly need a new William James to expound the beauties of economic pragmatism.

H. W. M.

10.—*The New Industrial System*, a Study of the Origin, Forms, Finance, and Prospects of Concentration in Industry. By Hermann Levy. London: Routledge, 1936. 8 $\frac{3}{4}$ " \times 5 $\frac{1}{2}$ ". x+282 pp. 10s. 6d.

Mr. Levy quotes Professor Gregory as declaring that "the trust movement hinders the development of industry," and we must, therefore, conclude that he, as well as Professor Robbins and other defenders of the principle of competition, received a severe shock when, on reading a "white paper" with the innocent title "Memorandum on Clause 6 of the Finance Act, 1936" (Cmd. 5201), they discovered that the Government was not only supporting a domestic cartell in iron and steel, but also encouraging an international cartell, and that the Import Duties Advisory Committee is, if not precisely controlling the prices of iron and steel products, at least indicating how far changes in them may be permitted. This is a far cry from the rugged individualism of the nineteenth century. Monopolies and financial control have for centuries been adopted in British industry whenever the circumstances of the time allowed their exploitation, but nevertheless the general attitude to-day is quite different from what it was when the clothiers financed the textile industries and the coal trade of Newcastle was governed by

the Vend. The great majority of industrialists are now in favour of forms of organization which will combine freedom in the management of their business with protection against the worst forms of internal and external competition. Moderate policies regarding prices and control of workpeople have dispelled some of the fears of industrial tyranny which originated in experience of the early trusts in the United States. More subtle methods of financial control through interlocking directorates, on the other hand, now require attention, and the new demands made on the banks to help in the rationalization and reconstitution of industry may involve modifications of our financial system.

It is not to be supposed that the changed attitude towards industrial concentration necessarily implies that the business world to-day looks more kindly on "nationalization." Quite the contrary, but the more progressive minds are groping towards a shift of industrial control from large independent units to various forms of public utility companies allied in various degrees of combination. The State's functions are conceived to be to advise, to aid, and where necessary to control in the interests of the community; the import tariff, as administered to-day, has put a powerful weapon in the hands of the Government. Mr. Levy is an experienced student of trusts and combinations, and one is disposed to acclaim the present book as the best he has written on the subject. No one can hope to understand the situation of to-day unless one studies its development in history, and in this task Mr. Levy will prove an invaluable guide. His book is full of relevant data and of acute observation. We must thank him also for providing us with an occasional lighter aspect of serious problems, and in particular for this priceless quotation (p. 28) from Sombart's *Deutscher Sozialismus*: "We are now becoming ripe for a stationary economy and are sending the 'dynamic' economy to where it came from—to hell."

H. W. M.

11.—*The Framework of the Pricing System*. By E. H. Phelps Brown, M.A., Fellow of New College, Oxford. London: Chapman and Hall, 1936. $8\frac{3}{4}'' \times 5\frac{1}{2}''$. xvi + 221 pp. 10s. 6d.

Let us say at once that this book affords the best defence within our knowledge of the utility of abstract theory and in particular of the doctrine of margins. Its intention is "to take the barest framework of the pricing system, and to expound it so that the student may take hold of the propositions stated in the exactness of abstraction, may see the place of pure theory in the whole of economic study, and may be guided in the paths of quantitative thought." This intention is fulfilled, for the book is a model of clarity. Not that it is easy reading, for the form of thought is mathematical though without symbolic notation. To take a universe of idea, to split it into parts, to analyse each part with logical severity, and then to reconstitute the whole in such a way as to present new aspects both of the whole and of the parts, is a severe mental discipline both for the writer and the reader, but although, as is admitted, no direct application to the problems of everyday life is possible, a better appreciation

may be attained of the relations of the components and of the factors which enter into the solution of the problems of the market. Certainly this book avoids the danger not absent from some of "the great non-mathematical text-books," which, aiming to "illuminate the daily and secular processes of economic life," have by their admixture of theory and current problems misled the layman to thinking that theoretic generalities provide "laws" of conduct.

Mr. Brown's method is to divide the pricing problem into two problems—consideration of the consumers' market, how, under given conditions, the prices and quantities of goods bought are determined, and consideration of the producers' market, how, again under given conditions, at what prices and in what quantities the several productive factors are acquired by entrepreneurs for the production of the goods bought by the consumers. The "working models" of these two markets are then combined and modified by taking account of the origin of incomes and the effects of price on the supply of the productive factors. It would be impossible in a brief space to do justice to the analysis, and, therefore, unfair to Mr. Brown to attempt it. But one point must be singled out for particular commendation; usually in theory the separate factors of production are regarded as varying independently of each other, but Mr. Brown clearly sees that a marginal product cannot be looked for in those cases where "the productive factors must be used, one man one spade, in fixed proportions." Those cases are characteristic of manufacturing production, and each reader must judge for himself how far Mr. Brown is successful in showing how the prices of the factors are determined in such circumstances and to what extent his method throws light on what we see taking place before us. In the last chapter the author briefly indicates how the preceding studies may be affected or modified by consideration of the theory of capital and interest, by the introduction of "economic dynamics," by bringing in the theory of money, by taking the firm instead of the individual entrepreneur, and by the undertaking of field work and statistical analysis. The relation of the collection of facts to theory is well expressed—"fact-study without theory is blind, theory without fact-study is empty." The true method is—"the facts suggesting theory, and the theory fitting the facts together, or, breaking against some of them, returning to the thinker for re-making, and forcing him to look for further facts." H. W. M.

12.—*Economics and Technology*. By Ferdynand Zweig, Professor of Political Economy in the University of Moscow. London: King, 1936. 8 $\frac{3}{4}$ " \times 5 $\frac{1}{2}$ ". 252 pp. 10s.

"Technological motives are directed towards the attainment of the best results from physical, chemical, or biological entities, while economic motives are directed towards the attainment of best results from exchange entities." These motives are often in conflict, but technology is the greatest dynamic force affecting economics. There are three stages: Primitive Technology, the stage of primitive tools and individuals; Qualitative Technology, the stage of workshop tools and small groups; Quantitative Technology, the stage of the

machine and large groups. There are also three categories of development: (a) progress in productivity, involving a saving in the cost of production per unit of output, through mechanization, rationalization, industrial psychology, and industrial organization, resulting usually in the substitution of machines for labour; (b) progress in quality of the product; and (c) progress in novelty by the production of new consumption goods. The two last create additional employment, except when old forms of goods are replaced by new. Technological progress usually takes the form of substituting a larger proportion of capital goods, but it may also deconcentrate or reduce the ratio of such capital, *e.g.* in the substitution of the motor-car for the railway train, and the latter is the ideal of progress as it brings the small man to the fore again.

Technological unemployment may be absorbed by increased production, but this compensation depends on the rise in production and the time it takes; if inventions follow fast on each other the labour market gets no time to adjust the fluctuations. For an individual industry the elasticity of demand, the magnitude of the fall in costs, and the freedom of the market from monopoly are the chief factors causing an increase in production. But there will also be repercussions on the national economy according as increased profits lead to greater spending or greater saving, with corresponding influences on employment, again if the market is free. Favourable repercussions may also occur in the world economy, leading to increased trade and employment. Mechanization produces less displacement of labour than rationalization and the other factors, for in its case there is compensation in the increased number of machine-builders. In agriculture there is little compensation, but progress in transport brings general improvements and more work in its wake. Pre-war experience showed a close relation between increase of productivity and growth of population and of employed persons, but post-war statistics indicate that in the recent period compensation for technological unemployment in the United States (most of all), England, and Germany was "partial and insufficient," partly due to the loss of capital and general impoverishment caused by the war. The problem of compensation is simpler in times when capital and population are rapidly increasing, but is made more difficult by a declining birth-rate in the property-owning classes.

Technological progress increases the National Dividend, but in a state of free competition reduces nominal wages through a falling demand for labour and the substitution of machines for labour and unskilled for skilled labour; it will increase real wages if the progress is in industries producing necessities. Interest will rise owing to the increase in profits and the larger demand for capital and credit. Land rent will fall with a stationary population. Prices generally fall. There is a redistribution of incomes in favour of the capitalist against the landlord, of the new capitalist against the old, of the large capitalist against the small, of those in the new occupations against those in the old, and, through rationalization, there will follow a great increase in clerical and distributive workers and a relative decrease in industrial workers. It tends towards monopoly,

it "widens the gulf between the possessing and the non-possessing class," and "does not bring about an improvement in the distribution of wealth," though, through the fall in prices, part of the benefits accrue to the non-possessing class. Progress cannot be effectively controlled, but might be directed to reducing the importance of expensive plant, to improving the quality of consumption goods, and to cheapening transport and communications; above all, "the development of military technique is a universal calamity." Reduction of working-time is a palliative, but unless accompanied by a maintenance of earnings it only spreads the burden of unemployment. "Credit expansion lays a burden on the future." Public Works are "the most expensive and least effective remedy for unemployment."

The author's conclusion is: "Without the dissolution of monopolies and semi-monopolies and without a *return to world economy*, the absorption of technological unemployment will become a matter of great difficulty with further technological progress. Monopolistic and autarchic economic systems will be faced with a choice of two alternatives: either a complete standstill of technological progress, or a thorough reconstruction of the system of ownership on the basis of the structural elimination of unemployment."

If the author has not found any easy solution of the problems he poses, he is at least to be commended for his careful and thorough examination of the nature and effects of a development which has worried economists from Ricardo onwards. Only in this way can any progress be made, and Professor Zweig has made a notable contribution to economic thought by setting out the conditions and nature of technological progress and the economic effects that flow therefrom.

H. W. M.

13.—*The Consequences of Post-War Price Changes*. By K. T. Shah. Delhi University Publications, No. 6. 1935. 9½" × 6¼". 251 pp.

The author, the well-known Bombay economist, explains in a preface written in September 1935 that the book consists of a course of ten lectures delivered at the Delhi University in March 1934, put into a form suitable for publication, and that an "effort has been made to bring the material as nearly up to date as was possible." There is no index.

After sketching in the introduction the general scope of the course, the author describes in the second lecture the economic situation in the world at the end of the war. Then follows a clear and logical exposition of the marginal utility theory of values and prices, together with an enumeration of the reservations and limitations which govern the practical application of the theory. This is perhaps the best chapter in the book. In an appendix to this chapter an explanation is given of the principles underlying the compilation of index-numbers of prices, together with a reproduction of the *Statist* index-numbers for 1919 to 1927. Succeeding lectures deal with the general economic history of the world during "the Period of Re-

construction 1929-1934," "the Period of Rationalization 1924-1929" and the "Period of Depression 1929-1934." Between the two last-named lectures is inserted one devoted to a description of economic conditions in the United States from the time of the Great War down to the first stage of the Recovery programme of President Roosevelt. In the lecture dealing with the period of Depression, Professor Shah has incorporated an account of the World Economic Conference of 1933, in which the recommendations of the Preliminary Committee of Experts, the resolutions of the Conference itself and the comments of the lecturer have been inextricably mixed up, much to the confusion of the reader. The author then proceeds to describe what he calls the "Russian Experiment." Here the introductory passages surveying the economic history of the country in the ten years following 1918 are clear, though brief; the lecturer furnishes a summary of the first Five-Year Plan—namely, what was aimed at and what was actually achieved—but one feels that, for the benefit of the student in India, it would have been more satisfactory if the lecturer had explained the mechanism of the Plan; in other words, how it was intended that the Plan would be accomplished and how the process affected the urban and rural population of Russia in their daily life. The book ends with a short chapter on "Economic Nationalism," followed by a summary of conclusions.

An obvious criticism is that the work is an attempt to deal with a large and complex subject within a very restricted compass, but presumably this was inevitable in a scheme of ten lectures. With this limitation there is little fault in the purely narrative portions of the work, and the excellent analysis of the theory of values and prices has already been mentioned. The author has made extensive use of the publications of the Economic Section of the League of Nations Secretariat and the International Labour Organization and acknowledges his debt handsomely at p. 71 of the book. Unfortunately, however, apart from the blemish of numerous printing mistakes (which are always regrettable in a work of this type), the author frequently lapses into irrelevant political theorizing, which mars the value of his historical and statistical analysis. As an example of this fault the following passage may be quoted: "Trade will be an engine of Imperialism, and production a means of local exploitation of the masses by the propertied classes so long as commerce rules the world, and profit-seeking inspires the individual" (p. 203).

A. C. C.

14.—*The History of Milk Prices. An Analysis of the Factors Affecting the Prices of Milk and Milk Products.* By Ruth L. Cohen. Issued by the Agricultural Economics Research Institute, Oxford. 1936. 205 pp. 5s.

At the present time, when milk is an item of news and its supply and price are questions of national importance, this unbiased analysis is more than welcome. It shows only too clearly the immense complexity underlying the seemingly straightforward question, "What are the factors which determine milk prices?" And while it does not

claim to provide a complete solution, it certainly sheds light on the intricacies of the subject.

The problem is made more perplexing by the fact that during the last 30 years the trade in milk has changed by successive stages from completely individualistic unorganized bargaining to virtually complete price control. In pre-war days, each farmer sold his produce according to his own judgment: he might sell all or part of his output on contract, or send it for sale speculatively at certain railway stations, or make it into farmhouse butter or cheese, and he might adopt all or any of these methods simultaneously or at different seasons of the year. At this time there was no monopoly, and the competitive relationship in the prices obtained was dependent on the situation of the farm, the opportunities for sale in near or distant markets, and on the prices of imported dairy produce. In the post-war period all this was changed, new ideas were introduced, and farmers turned to organized bargaining between producers and distributors as a means of escaping from the drastic fall in prices; in 1933 this voluntary system developed into compulsory price control and organization of selling under the Milk Marketing Board.

These successive stages in the history of the industry are analysed by Miss Cohen in great detail, and show how the factors which determine the prices of the various products have been modified by the changing structure of the industry. In particular, the introduction of the Milk Marketing Scheme, with its control of home-produced sales, has altered almost entirely the nature of the link which united the prices of the various milk products. The chapter dealing with this new development, with its current interest, is of special value, though the period covered is too short for more than tentative conclusions.

It is interesting to notice that Miss Cohen agrees that the Marketing Scheme in the conditions then existing was practically inevitable. Voluntary organized bargaining was for a number of years able to maintain liquid milk prices in the face of a position which in pre-war years would have led to a decline. By 1933, however, the position had become highly unstable, and if at this stage prices had been left uncontrolled, the organization, such as it was, would have broken down and a disastrously low price level would have been reached, with the possibility of a subsequent shortage. Thus some artificial control was probably called for as much in the interests of consumers as of producers, though there may be a danger of consumers' interests being unduly subordinated.

The book is essentially a history of milk prices, and as a study of the progressive development of the trade in milk and dairy products, it is deserving of great praise. All the available statistical data seem to have been utilized, and there are a number of interesting diagrams.

R. J. T.

15.—*Agriculture and the Trade Cycle.* By John H. Kirk. London: P. S. King, 1933. 8 $\frac{3}{4}$ " \times 5 $\frac{3}{4}$ ". 272 pp. 12s.

This study consists of two parts, the first dealing with the effects of trade cycles on agriculture, and the second concerning the respon-

sibility of agriculture for trade cycles. After examining the conditions of supply of, and the demand for, agricultural produce, the author is logically led to the question of marketing. This particular chapter, however, which is illustrated to some extent by mathematical reasoning, does not refer to the modern features of international regulation and voluntary restriction of exports. Quantitative regulation is, to-day, regarded by a very influential school as the only policy for this country's agricultural salvation; the effect of this principle in practice, with special reference to price control, would have considerably strengthened this particular chapter. A brief reference to this subject, however, is given in the subsequent chapter entitled "Agricultural 'Crises.'" Part I concludes with an account, descriptive and analytical, of some problems of overproduction.

Part II consists of three chapters. The first discusses certain theories of the trade cycle, and it is concluded that there is possibly an element of truth in each of them. The complicated inter-reaction of each on most, if not all, of the others makes it impossible to assess the degree of truth in any particular one.

The second of these chapters is concerned with fluctuations in agricultural activity, and the third with the cycle of the production period. Five appendices and an index complete the book.

The general impression made by this study is that the descriptive treatment of the subject is more worthy than the analysis, which tends to be too briefly discussed and dismissed. Moreover, the conclusions to which reference is made in the Preface are at times somewhat obscure. The book is nevertheless a pioneer effort, and should stimulate further enquiry into a subject which has not received the attention it deserves.

R. F. G.

16.—*Agricultural Credit, being a Study of Recent Developments in Agricultural Credit Administration in the United States of America.* By Anwar Iqbal Qureshi, Trinity College, Dublin. London: Pitman, 1936. $8\frac{1}{2}'' \times 5\frac{1}{4}''$. 190 pp. 7s. 6d.

Agricultural credit has been developed in the United States to an extent which has no parallel in any other part of the world. In part this has been due to the fact that the prevailing form of tenure is that of individual ownership, with a consequent high dependence on mortgage facilities, and in part to the inefficiency of the ordinary banking system. In the main, however, the magnitude and variety of schemes for the provision of agricultural credit are the consequence of the disastrous fall in prices and in land values, which since the war, and especially since 1929, have threatened farmers with financial disaster and bankruptcy. To the recurrent crises thus engendered, agricultural credit in larger and larger doses has seemed both to farmers and to the Government to offer an obvious and hopeful way of escape. How far it has really done so only time will show, but those interested in the question will hardly find a more intelligible description of the jungle of legislation, enlightened by judicious criticism, than is given in this book.

The author, after an historical introduction, describes in detail the operation of the various federal agencies and their subsidiaries

created to provide credit to farmers between 1916 and 1932. The most important of these were the land banks and the intermediate credit banks, but there were many ramifications, and, as the author remarks, "a reader is baffled by the cumbersome multiplicity of these institutions." At the beginning of 1933 there were five different federal farm credit agencies catering for the needs of farmers and deriving funds from the Government, without any central co-ordination, and more often than not competing with each other. In 1933, under the shadow of the banking crisis, President Roosevelt consolidated the existing agencies, while a fresh Act provided for two new groups of institutions—Production Credit Corporations and Banks for Co-operatives—the whole being organized under the Farm Credit Administration, the aim being to provide a complete and unified system of agricultural credit.

The situation which the new administration was called upon to face was acute. The total farm debt was large, and most of it had been incurred when land values were more than double, with the consequence that the security to lenders had become very shaky, while in addition the farmer's ability to pay his debts was undermined by low prices. "If he borrowed when the index number of commodities he sold was 110, and had to pay in 1932, when the index number of these commodities had fallen to 43, the amount he had to pay in commodities was almost three times the amount when he borrowed." The outlook for farmers was dark indeed. However, relief was afforded by emergency measures, no less than 1,250 million dollars being provided through the various credit agencies in the first year of operation. Thus the Farm Credit Administration achieved significant results, though the author reserves judgment as to the permanent value of the whole organization, as in 1934 it was working under exceptional circumstances and the possibilities of its future development could hardly be foreseen.

Taken as a whole, the book is a most interesting and clear-sighted review of American credit legislation. A useful introduction is provided by Mr. Joseph Johnston, Fellow and Tutor of Trinity College, Dublin.
R. J. T.

17.—*Fluctuations in American Business 1790-1860*. By Walter Buckingham Smith and Arthur Harrison Cole. Cambridge, Massachusetts: Harvard University Press. 1935. 11" × 8½"; xxx + 195 pp. 21s. net.

This work forms the fiftieth number of the series of Harvard Economic Studies. The authors disavow any intention in the present volume to write a general economic history of the United States for the period selected. Their primary aim has been to collect and publish a number of important time-series referring to commodity prices, stock prices, sales of public lands, interest rates and so far as possible the volume of trade, aspects of business conditions for which adequate data have not hitherto been available for the pre-Civil War period of American history. The writers point out that the lack of such co-ordinated facts has resulted not only in a wrong interpretation of the causes of episodes like the "panic" of 1837, but also in

"unwarranted comparisons with disasters of more recent date." In the laborious and extensive research thus undertaken, Professors Smith and Cole have, as was to be expected, mainly utilized original sources, particularly newspapers and manuscript records, such as those of the Land Offices. At the same time the authors have abstained from "extended statistical manipulation," partly because in their opinion "raw data" are likely to be more useful to economists, with their varying interests and requirements. A very interesting example of the methods adopted by the authors is explained at pp. 44 and 45 in connection with the construction of the time-series relating to the prices of common stocks between the years 1815 and 1845. Very full descriptions of the sources of data and the statistical methods used have been furnished in the appendices. The numerous tables in the body of the work are self-explanatory, while the charts which constitute the pith of this excellent volume, drawn mostly to a vertical logarithmic scale, are remarkably clear and comprehensive.

The authors have rightly divided the work into chronological periods. As they say, the periods, for the purposes of presentation, should be long enough to ensure proper perspective, and yet not so large as to prove unwieldy. Professor Smith has dealt with the first period chosen—namely, 1790 to 1820. Professor Cole is responsible for the two following periods, 1820 to 1845 and 1845 to 1862. In all three periods both authors have in many suggestive passages drawn the attention of the reader to similarities in economic situation and consequent fluctuations in business conditions with changes that have occurred in more recent times, though they have at the same time pointed out the underlying differences. One significant observation is worth quoting:

"... Throughout the decades here under review, foreign influence continued to play an important, if not a predominant rôle. . . . The Peace of Amiens, or the impediments to foreign trade after 1807, are matched in later decades by the indirect influence on American markets of the Anglo-South American crisis of 1825 or the occurrences of the Crimean War. The persistence of foreign lending into 1839, or the curtailment of such loans in the 'forties, likewise has varying consequences for the American business situation. . . . Before the Civil War our bankers had learned that same dependence upon foreign, older banking systems which they were disposed or compelled to employ in our post-Civil-War crises."

In each of the three chronological periods into which the book is divided, the reader is provided with an introduction which lucidly and succinctly sets forth the economic setting of the period. Without attempting to write a full economic history of the decades dealt with, the authors give us an adequate background for the various business phases, which they proceed to study in detail in succeeding chapters with the aid of the charts to which reference has already been made. Occasionally one finds in these introductory chapters otherwise little-known facts, such as the wide use of bank cheques in the United States in the first decade of the nineteenth century. The aspects of business fluctuations treated in detail are commodity

prices, stock prices and sales of public land, foreign and domestic exchanges, banking and finance. Each period is concluded with a chapter of general observations and an explanation of the relationship between the different phases of business fluctuations dealt with in the preceding chapters. Among the conclusions set forth by the authors attention may perhaps be drawn to the following remark in the preface: "The speculative spirit of American citizens showed itself at an early date, manifested itself in various guises, and perhaps may be itself declared responsible for the creation of that instrumentality (the stock market) by means of which stocks and bonds are now passed from hand to hand."

The style of both authors is clear and vigorous, while limitations and reservations are always distinctly specified. The book will be welcomed by economists interested in the development of American business life in its formative period, and it will be equally useful for the student of history desirous of ascertaining the relationship between events in the old and the new worlds during the seventy years following the French Revolution.

A. C. C.

18.—*The Medical Dictator* and other Biographical Studies. By Major Greenwood, F.R.S., D.Sc., F.R.C.P. London: Williams & Norgate, 1936. 8" x 5½". 213 pp. 7s. 6d.

The public has become so accustomed to a debauch of superlatives in modern "reviews," that adjectives have almost ceased to convey any gradation. Fellows of this Society may rest assured that in this collection of essays they will find all those literary characteristics which they have learned to associate with the author—clear, succinct, and sufficient statement of facts, delicate characterization, and, above all, that flickering irony which touches lightly on the merely absurd, but bites like acid into the sham and the pretentious. There are four medical essays. The first, on Galen, provides the title for the book; he ruled undisputed over medical practice for more than thirteen hundred years, his anatomy and physiology have passed into "the stock of common knowledge," his medical principles are abandoned, and "it is *only* the psychological aspects of his teaching which have survived the collapse of Galenism as a medical system." In John Freind we have an eighteenth-century physician of the best type, who had no use for "hypotheses," but "went through ancient literature and modern literature searching for plain, practical remedies with no mystical nonsense about them"—a plain man, weak in science, but "a stout-hearted enjoying English gentleman and scholar." The essay on Latham, the heart specialist, a pragmatist in medical philosophy, who held that "as the knowledge of disease has increased, the practice of medicine has been less and less conversant with cures and more and more conversant with treatment," leads to a discussion of medical education and the proper way of ensuring that doctors have a training in scientific method. In the fourth medical paper Sir William Osler is gently conducted down from the dizzy pinnacle on which newspaper adulation had placed him, and we are sure that he, who "was wholly free not merely from pomposity, but from any vulgar self-seeking," would, with his feet

firm on the kindly ground, have appreciated and approved of the process.

There are two statistical papers. The first is on Farr, and from it we must forbear to quote, simply saying to the connoisseur of Professor Greenwood's writings that he will find it a type specimen—rather the best specimen—of this *genre*, complete but for the missing quotation from Bagehot. Yet one must refer to the defence of jobbery against technical expertness as a means for filling administrative posts, and perhaps some will confirm the assertion of “the complete absence of jealousy, or even a trace of acrimony which has so long characterized the relations of statisticians in all countries.” The second paper deals with Pierre C. A. Louis (1787–1872), who introduced the statistical method into clinical medicine and sought to advance the science by studying the association of symptoms. To-day “there are no clinical statisticians,” and “it is thought obvious that clinical statistics are only useful for two well-defined purposes: (a) the manufacture of M.B. theses; (b) the amplification of addresses to congresses.”

Of the beautiful tribute to his friend Arthur William Bacot, eloquent of the *desiderium cari capitis*, even a hardened reviewer cannot bring himself to say anything except to assure Professor Greenwood that one reader, at least, feels that Bacot has been made real and hopes that when he himself is gone he may be thought worthy of some such Vale!

H. W. M.

19.—Other New Publications.*

Bombay Labour Office. Report on an Enquiry into Working-Class Family Budgets in Bombay City. Prepared by the Labour Office, Secretariat Bombay. Bombay, 1935. 9½" × 6". 44 pp. 3 annas or 4d.

[According to a resolution which was passed by the Third International Conference of Labour Statisticians, “in order to provide adequate information with regard to the actual standard of living, enquiries should be conducted at intervals generally of not more than ten years into the income, expenditure and conditions of living of families.” This Conference also held that “it is preferable to ask for less detailed information than to reduce the number of families covered by the enquiry.” The Labour Office therefore followed up their first enquiry (of 1921–22) with the present one, adopting an extensive rather than an intensive method. They confined the enquiry to three predominantly working-class localities, and made no conscious selection of families except that only those were included whose heads were in full-time regular employment. The scope of the investigation covers religion and caste; birthplace; constitution of the family; age distribution; workers and dependents; earners in the family; family expenditure; housing; indebtedness. Tables are given which include classification of the budgets by religion and region of origin, by industries and occupations, by income groups, and according to the number of boarders and lodgers; of tenements by number of rooms and floor space and by number of occupants; of literacy amongst the heads of families by income groups; of average earnings and group expenditure by income groups. An appendix includes tables relating to expenditure on education, age and earnings of heads of

* See also “Additions to Library,” p. 620.

families, classification of families by earning strength and number of dependents, frequency distribution of monthly earnings of cotton mill workers by sex and main occupations, income and expenditure, and average surpluses and deficits in family budgets by income groups.]

Crowther (Goffrey). *Ways and Means: a Study of the Economic Structure of Great Britain To-day*. London: Macmillan, 1936. $7\frac{1}{2}'' \times 4\frac{3}{4}''$. 207 pp. 4s. 6d.

[The chapters of the book consist of the twelve broadcast talks given by the author at the end of 1935, with very slight modifications and various illustrative diagrams. Those who heard and profited by the talks will be glad to be able to digest the material at leisure, and many of those who do not, or did not, listen in, should be grateful for this straightforward, easily understood, and practical account, in everyday language, of "how the machine works." Technical terms and economic theory have been left out altogether; the reader is shown what is behind the familiar appearances of the "ways and means" by which he lives, in the economic sense of the verb. Among other things, he will realize that more of the workers in this country are now engaged in performing services than in making goods for home consumption, he will learn something of the changes which are taking place in the kinds of things consumed, and several facts about foreign trade which are often misunderstood or distorted. The sequence of the narrative is logical and it flows easily; none of it is dull or superfluous. The book is, of course, intended for those entirely unacquainted with economics and finance, and it would be excellent for use in schools.]

Gear (H. S.) and others. *Industrial Health in Shanghai, China: an Investigation of Printing Works*. Chinese Medical Association, Special Report Series No. 4. Shanghai, 1935. $9\frac{3}{4}'' \times 6\frac{3}{8}''$. 27 pp. 1s.

[This study is frankly not based on a sample which is representative in the statistical sense. The investigators encountered so much opposition, not only from owners, but also from employees suspicious of their motives, that they were only able to examine five works and 189 workers, and only 15 minutes were allowed on each occasion. Nevertheless, they have reason to believe that the conditions they found are representative in fact—and they are about as bad as they could be. The works were installed in small dwelling-houses, ill lighted, very badly ventilated, and unspeakably dirty; many of the employees were unfit for handwork, yet the working day was 10 to 15 hours long. Most of the owners and managers admitted the need for improvement, but declared themselves helpless in the fiercely competitive conditions which obtain. The authors concluded that industrial hygiene was "non-existent and almost hopeless of attainment in the absence of a general public health programme and government regulation of industry." Detailed results of the various investigations are given.]

Johns Hopkins University. *Collected Papers from the Department of Biology of the School of Hygiene and Public Health*. Baltimore, 1935. $9\frac{5}{8}'' \times 6\frac{3}{8}''$. Vols. XI and XII.

[Among the General Biology and Biometry papers we may mention, in Vol. XI, the fourteenth of the experimental studies on the duration of life "The comparative mortality of certain lower organisms" by Raymond Pearl and John R. Miner; "On the comparison of groups in respect of a number of measured characters," by the same authors; and "The influence of inheritance and environment on the milk production and butterfat percentage of Jersey cattle," by John W. Gowen. The space in the corresponding section of Vol. XII is mainly occupied by a reprint of an address by Professor Pearl to the Washington

* Academy of Sciences, on "Biology and human trends," which is full of interest. The same volume, in Part II, Human Biology, contains a paper by Professor Pearl on "The Birth-rate in recent years" and "A Biometric study of the endocrine organs in relation to mental disease," in which he has been assisted by Marjorie Gooch and Walter Freeman; also "Disproportionate shortening of bone conduction: a statistical and clinical study," by A. Cioceo, who contributed to Vol. XI "A statistical approach to the problem of tone localization in the human cochlea."]

Milbank Memorial Fund: Collected Papers on Research, 1935. 8 $\frac{3}{4}$ " \times 6".

[The volume opens with the Seventh Annual Report of the Fund, which gives a brief outline of the researches undertaken in 1934. The collected papers which follow give the results of their researches; the majority of them appeared in the Milbank Memorial Fund Quarterly. Divided under the heads of Public Health Administration, Health and the Depression, Epidemiology and Vital Statistics, Population, and Other Studies, the papers include: Age incidence of tuberculosis and its significance for the administrator (Jean Downes); Causal and selective factors in sickness (G. St. J. Perrott and Edgar Sydenstricker); Height and weight of children of the depression poor (Carroll E. Palmer); Relation of sickness to income and income change in 10 surveyed communities (G. St. J. Perrott and Selwyn D. Collins); Group infection and immunity during a scarlet-fever epidemic in a boys' school (B. Zuger); Recent trends in mortality in the United States (Dorothy G. Wiehl); Factors affecting variations in human fertility (F. W. Notestein and C. V. Kiser); Fertility of Harlem negroes (C. V. Kiser); Life tables for Chinese farmers (H. E. Seifert). A list of "Other Papers Published" is appended to the table of contents.]

The Monetary Problem: Gold and Silver. Final Report of the Royal Commission appointed to inquire into the recent changes in the relative values of the precious metals. Presented to both Houses of Parliament, 1888 . . . Edited by Ralph Robey. New York: Columbia University Press, 1936. 9" \times 6". xxviii + 369 pp. 17s. 6d.

[Dr. Nicholas Murray Butler explains in a foreword that the Carnegie Endowment for International Peace has been able, with the permission of the British Government, to reproduce in convenient book form this classic Report, which has long been out of print. Since the questions therein discussed still remain unsolved, and have become a matter of vital interest for the whole of the civilized world, the boon conferred on students of monetary problems is not confined to the American enquirers for whom it was no doubt primarily intended. The editor, who is instructor in banking at Columbia University, has contributed a useful introduction. After indicating the characteristics of the English as contrasted with the American monetary controversies, he sketches the development of the Bank of England's policy from the Report of the Bullion Committee of 1810 to the appointment of the Commission. It should be added that this American edition of the Report has the advantage of a good index.]

Scanlan (F. J.). Money Matters. London: P. S. King, 1936. 7" \times 4 $\frac{1}{2}$ ". 150 pp. 6s. net.

[This is neither a treatise nor a textbook, nor does it offer any specific plan. The author (whose earlier book, *The Pound's Progress*, was briefly noticed in the JOURNAL, Part IV, 1935) has rather aimed at calling attention to a number of facts which should be taken into account when economic and financial policies, and particularly stabiliza-

tion, are being considered, and at refuting mistaken ideas about the monetary policy pursued by this country since the departure from the gold standard. This he has done in a series of chapters each dealing with a special feature or aspect of the general problem. Wide reading, acute observation, honest thinking, and apt expression have contributed to make a readable and interesting book, the conclusions of which are supported by relevant figures and references to authorities. The proof reading might have been more careful: the British representative at Geneva is quoted as having advocated the "revival" of the impediments to the exchange of goods, and there are other slips.]

Singh (Kartar) and Singh (Ajaib). Family Budgets, 1933-34, of Six Tenant-Cultivators in the Lyallpur District. Being the second year's accounts of some cultivators on the Risalewala Farm near Lyallpur. Punjab: Board of Economic Inquiry, 1935. 9 $\frac{3}{4}$ " \times 6 $\frac{1}{2}$ ". ii + 43 pp. 6 annas.

[Earlier publications of the Board have dealt with farming in the Punjab from the side of the cultivation of crops, but until 1934, when "Family Budgets, 1932-33, of Four Tenant-Cultivators in the Lyallpur District" was published, no investigation had been made into that side of the subject relating to the income and expenditure of the farmer and his family. This is the second of the series. The matters studied are the cost of various items of household expenditure, the extent to which this expenditure is met by the produce of the farm, various sources of the family income, and the extent of employment of the members of the family. The lines of presentation followed are the same as in the previous year, except that this time for purposes of comparison the period of study has been made to coincide with that covered by the Board's publications "Farm Accounts in the Punjab" (June 1933-May 1934, the first investigation having dealt with the period November 1932-October 1933). By far the largest proportion of the expenditure is on food, 67.9 per cent., the second largest on dress, 16.4 per cent., while the smallest are on housing and education, each 0.3 per cent. Travelling, religion, social functions, medicines, light, amusement and luxuries comprise the rest of the items, the expenditure on which ranges from 5.9 per cent. for the first to 0.8 per cent. for the last.]

"Taxation." Key to Income Tax and Surtax, 1936-37. 160 pp. 8 $\frac{1}{2}$ " \times 5 $\frac{1}{2}$ ". London: Taxation Publishing Co., 1936. 3s. 6d.

[The book is divided into the following twelve sections (thumb-indexed under each head and under the main divisions of each head): Tax Rates and Allowances (this includes figures for all years back to 1899-1900); Returns and Assessments; Land and Property; Businesses and Professions; Employments and Offices; Wear and Tear, Obsolescence, etc.; Interest and Dividends; Repayment Claims; Charities. Trustees. Husband and Wife; Dominion and Foreign; Sur-tax and Super-tax; Irish Free State. Back Duty. Grossing Tables. Practical examples are included and references given to Acts and cases. The first page of each Section contains a list of contents and an index.]

STATISTICAL NOTES.

1. BRITISH OFFICIAL STATISTICS.

ON page 596 we give our usual table summarizing the oversea trade of the United Kingdom for the years ended June, 1935 and 1936. For the year 1935 imports exceeded exports of merchandise by £276 million. In the twelve months ended June this was increased by £38.5 million, owing to an expansion in retained imports, exports of United Kingdom goods showing little change. The excess of imports in the second quarter of this year was approximately equal to that in the first, and if this continued for the remainder of the year the excess for the whole year would be about £325 million. Recent increases in imports can, however, hardly have been entirely for home consumption, and the expansion in exports which was in progress from the middle of 1933 to the end of 1935 may well be resumed in the absence of any major disturbance affecting international trade. It may be noted in particular that the loss of exports to Italy in the first half of the year compared with a year earlier amounted to about £4.1 million, and now that trade between the two countries is unhampered by sanctions, though still hampered by payment difficulties, some increase in exports may naturally be expected. In the circumstances the adverse merchandise balance for the second half of the year is not unlikely to be less than in the first half, and the excess of imports for the year may be under £320 million.

Total imports during the second quarter of the year were valued at £202.5 million as compared with £181.0 million in the second quarter of 1935. Re-exports increased from £14.9 million to £16.5 million. The increase in re-exports has been largely due to the policy of the Soviet Union in buying such goods in this country instead of direct, but the United States have also increased their purchases of our imported merchandise. The increase was primarily in re-exports of non-ferrous metals and rubber.

The value of retained imports of food, drink and tobacco amounted to £88,024,000, being £7,198,000 more than in the second quarter of 1935. As in the first quarter, meat was the only group for which a decline of any significance was recorded, imports of mutton and lamb and bacon being smaller and those of beef slightly greater. In addition, imports of cattle from the Irish Free State continued to be on a larger scale than a year earlier. Retained imports of wheat and flour rose to only a small extent, but there was a marked

increase in imports of barley and maize. Among dairy products there was a small decline for butter and some increase for cheese. Imports of eggs increased by over 20 per cent., continuing the expansion which has been in progress since early in 1935. A substantial increase was also recorded last quarter for tea, sugar and tobacco, and for apples, oranges, potatoes and most other descriptions of fresh fruit and vegetables except bananas, lemons and onions.

Retained imports of raw materials rose by £7,849,000 to £50,195,000, increases being recorded for each of the groups except rubber and non-ferrous ores and scrap. For rubber a marked decline in imports and increase in re-exports led to the latter exceeding the former by 3,300 tons, the difference in value being about £900,000. Among commodities showing increases may be mentioned cotton, iron ore, tin ore, soft wood, palm oil and dry hides, these commodities having also shown a considerable expansion in the first quarter of the year.

An increase from £42,166,000 to £46,594,000 was recorded in retained imports of articles wholly or mainly manufactured. The increase in re-exports of non-ferrous metals was larger than that in imports, mainly owing to heavy re-exports of copper and tin, but for most of the groups an increase, as in the first quarter, was recorded. The principal increases were in respect of iron and steel—from 247,000 to 349,000 tons, and in machinery—from 19,300 to 25,800 tons, the increase in value for machinery being about £1.5 million and for iron and steel about half that amount. There was, on the other hand, a marked decline in imports of motor cars.

The value of exports of United Kingdom goods in the second quarter amounted to £101,809,000, or £833,000 more than a year earlier. As in the first quarter, there were increases in exports of food, drink and tobacco and manufactured goods and a decline in exports of raw materials. The expansion of £709,000 in food, drink and tobacco was due, as to £578,000, to larger exports of spirits, mainly to the United States, while exports of beer likewise showed a substantial increase. The decline of £842,000 in respect of raw materials was less than in the previous quarter, being due essentially to smaller exports of coal. The latter amounted to 1,328,000 tons (14 per cent.) less than a year earlier, exports to Italy declining by 1,022,000 tons, and to France, Egypt and Belgium by over 100,000 tons in each case. There were no increases in excess of this figure, but Finland and Denmark each took over 80,000 tons more than a year earlier. Bunker coal shipments declined by 204,000 tons (7 per cent.). It may be noted that, notwithstanding these declines

and the similar declines for the first quarter, the output of coal in the first six months of this year was the highest recorded since the first half of 1930. Exports of wool, as in the first quarter, declined by about 40 per cent., owing mainly to smaller exports to Germany. Exports of manufactures increased from £78,343,000 to £79,082,000, woollen and worsted yarns and manufactures increasing by £676,000 and vehicles by £565,000, while substantial declines were recorded for cotton goods and non-ferrous metals.

As in the first quarter, exports of iron and steel goods were smaller than a year earlier, the decline in each quarter being primarily due to smaller exports of pig iron, uncoated plates and sheets and galvanized sheets, while in the second quarter only there was a substantial increase in exports of railway material. The aggregate decrease amounted to 43,000 tons (7 per cent.). Exports of machinery also declined, by 6,200 tons (6 per cent.), mainly due to a continuance of the decline in respect of textile machinery. Locomotives and other rolling stock were exported in larger quantities than a year earlier, the expansion in exports of motor cars continued and the number of pedal cycles exported was the highest recorded for any quarter since the war.

The reduction in the value of cotton goods exported referred to above resulted from smaller exports of piece-goods, exports of yarns being higher than a year ago. Piece-goods declined from 456 million to 417 million square yards, India taking 44 million square yards less; the quantity exported to India last quarter (89 million) was the lowest recorded since the fourth quarter of 1931. Exports to other markets showed no substantial change apart from continued larger exports to Egypt. Among woollen and worsted goods, exports of tops and yarns were slightly less than a year ago, but the expansion in respect of tissues and carpets continued. The increase in exports of artificial silk piece-goods likewise continued, but there was a decline in exports of linen and jute piece-goods.

The small increase in the value of exports during the past quarter resulted from an increase in average values, as it is estimated in the *Board of Trade Journal* for July 23rd that, eliminating price changes, the volume of exports was about 1 per cent. less than in the second quarter of 1935. Imports increased in volume by 6 per cent., while re-exports declined by 2 per cent. Average values of imports were about 5½ per cent. above those of the second quarter of 1935 and average values of re-exports increased by no less than 13 per cent.

Movements and Classes.	Twelve Months ended 30th June, 1935.	Twelve Months ended 30th June, 1936.	Increase (+) or Decrease (-).			
Imports, c.i.f.—	£'000.	£'000.	£'000.			
Food, drink and tobacco	345,563	369,146	(+) 23,583			
Raw materials and articles mainly un- manufactured	204,564	229,018	(+) 24,454			
Articles wholly or mainly manufac- tured	174,770	197,315	(+) 22,545			
Other articles	3,701	4,887	(+) 1,186			
Total Imports ...	728,598	800,366	(+) 71,768			
Exports, f.o.b.—						
<i>United Kingdom Produce and Manufactures—</i>						
Food, drink and tobacco	29,868	33,636	(+) 3,768			
Raw materials and articles mainly un- manufactured	50,505	50,764	(+) 259			
Articles wholly or mainly manufac- tured	319,746	330,197	(+) 10,451			
Other articles	12,638	12,739	(+) 101			
<i>Imported Merchandise—</i>						
Food, drink and tobacco	12,434	11,984	(-) 450			
Raw materials and articles mainly un- manufactured	27,673	30,435	(+) 2,762			
Articles wholly or mainly manufac- tured	10,614	16,152	(+) 5,538			
Other articles	349	258	(-) 91			
Total Exports ...	463,827	486,165	(+) 22,338			
Bullion and Specie—						
Imports	257,528	217,649	(-) 39,879			
Exports	146,150	158,355	(+) 12,205			
Movements of Shipping in the Foreign Trade—	Number of Vessels.	Thousand Tons Net.	Number of Vessels.	Thousand Tons Net.	Number of Vessels.	Thousand Tons Net.
<i>Entered with cargoes—</i>						
British	24,096	35,582	24,284	36,968	(+) 188	(+) 1,386
Foreign	24,598	26,593	25,657	28,733	(+) 1,059	(+) 2,140
Total entered ...	48,694	62,175	49,941	65,701	(+) 1,247	(+) 3,526
<i>Cleared with cargoes—</i>						
British	28,572	33,728	29,096	34,049	(+) 524	(+) 321
Foreign	21,058	22,692	21,092	22,753	(+) 34	(+) 61
Total cleared ...	49,630	56,420	50,188	56,802	(+) 558	(+) 382

Movements of bullion and specie were more active during the second than during the first quarter of the year with, as usual, a substantial excess of imports. Imports amounted to £61·8 million and exports to £20·7 million. For the six months the import excess was £67·5 million, as compared with £63·8 million in the first half of last year.

There was little change in the general level of *wholesale prices* during the three months March to May, 1936. As measured by the Board of Trade Index Number (1930 = 100) prices rose from 91·7 in February and March, 1936, to 91·9 in April and May. The index number for food advanced from 88·1 to 88·2, and that for materials, etc., from 91·7 to 91·9. Within the groups a decline in the prices of meat and cereals was counterbalanced by an increase in those of other articles of food. As regards materials there was the usual seasonal fall in coal prices and a decline in those of oils and of textiles other than cotton and wool. On the other hand, there was a rise in the prices of iron and steel, cotton, and wool. The rise in the prices of iron and steel has been continuous since the low level of June to Sept., 1932, when the index number had fallen to 90·8; it was 104·7 in May, 1936, a rise of 15 per cent., and since then the prices of certain descriptions have advanced. Wool prices were at a higher level in March to May, 1936, than at any time since April, 1934, and in May were more than 17 per cent. in advance of those current in May, 1935. Prices of mutton and tea showed some advance due in the case of the latter principally to the increase of 2*d.* per lb. in the customs duty. There was a seasonal fall in the price of butter, and the price of tin was lower than for many months past. The index numbers for the last four months are given below :

AVERAGES FOR THE YEAR 1930 = 100.

	Total Food.	Total not Food.	Total.	Basic Materials.	Intermediate Products.	Manufactured Articles.	Building Materials.
Feb. 1936 ...	88·1*	93·6	91·7	96·3	90·1	96·1	94·9
March „ ...	87·3	94·0	91·7	96·9	90·6	96·5	94·9
April „ ...	87·3	94·3	91·9	97·3	91·1	96·6	95·0
May „ ...	88·2	93·8	91·9	96·1	91·1	96·9	95·0
May 1935 ...	86·1*	89·5	88·3*	87·1	87·5	94·6	93·4
May 1934 ...	81·5	90·3	87·2	90·5	87·8	94·6	92·3

* Revised figures.

There has been some decline in the working-class cost of living during the last three months due to the usual seasonal decline in

the prices of food and fuel. The retail prices index number prepared in the Ministry of Labour to indicate fluctuations in the cost of articles of working-class consumption stood at 147 (July, 1914 = 100) in January and February last. It moved to 146 at the beginning of March, and to 144 at the beginning of June. The index number for articles of food fell from 129 at the beginning of March to 125 at the beginning of May, but rose one point to 126 at the beginning of June, chiefly due to slight advances in the prices of tea and butter, the increase in tea being due to the higher customs duty. There was also some slight increase in the index number for clothing, and that for rent moved forward from 158 to 159. As compared with the beginning of June, 1935, the general index number had advanced 4 points (from 140 to 144) or not quite 3 per cent., and the advance, though small, applied to all groups (food, rent, clothing, fuel and light).

The seasonal improvement in employment usual in the spring and early summer was somewhat more marked than usual in 1936, and the number of persons registered as unemployed at the Employment Exchanges of the Ministry of Labour fell during the three months from the end of February to the end of May by nearly 320,000. The improvement has been common to all the principal industries with the exception of wool and coal, and in the latter the decline is to a great extent seasonal. Unemployment was, however, still heavy in a number of important industries; in public works contracting it amounted to 41·2 per cent., dock, etc., service 33·7 per cent., shipbuilding 32·9 per cent., tinplate manufacture 30·7 per cent., jute manufacture 29·3 per cent. and shipping service 25 per cent. The percentage of unemployment among workers in Great Britain and Northern Ireland insured against unemployment (excluding workers in agriculture who have only recently become insured) was 13·0 at the end of May, 1936, 13·8 at the end of April, and 14·4 at the end of March. At the end of May, 1935, the percentage was 15·5. The total numbers on the registers of employment exchanges in Great Britain for the last four months are given below :

Date.	Wholly Unemployed.	Temporarily suspended.	Persons Nor- mally in Casual Employment.	Total.
Feb. 24, 1936 ...	1,677,077	250,292	88,652	2,025,021
March 23, „ ...	1,560,574	235,280	85,677	1,881,531
April 27, „ ...	1,498,579	247,272	85,379	1,831,230
May 25, „ ...	1,397,755	225,285	82,002	1,705,042
May 20, 1935 ...	1,641,969	314,775	88,008	2,044,752

The number of boys and girls aged 14 and under 16 on the registers at 25th May, 1936, was 54,184, of whom 25,814 were boys. The number aged 16 and under 18 was 46,463 (26,400 boys). Of these totals 11,439 boys and 12,481 girls under 16 and 23,990 boys and 17,286 girls from 16 to 18 were in the insured trades.

The Unemployment Insurance (Agriculture) Act, 1936, which extended compulsory unemployment insurance to agriculture (including forestry and horticulture), came into force on 4th May, 1936, and contributions became payable as from that date. Unemployment benefit does not become payable until 5th November next. Up to 25th May over 500,000 unemployment books for the affixing of contributions had been issued to agricultural workers at the Employment Exchanges. At that date 1,046 of these workers were registered as unemployed and are included in the figures given in the table above, which also includes any agricultural workers who have registered as out of work but had not at that date obtained unemployment books.

In continuation of previous tables (*Journal*, Part I, 1936, p. 211), the monthly index numbers of the prices of agricultural produce in England and Wales from January to June, 1936, and earlier years, as calculated by the Ministry of Agriculture, are given below (1911-13 = 100):—

			Jan.	Feb.	March.	April.	May.	June.
1936	...	...	119	118	116	123	115	116
1935	...	...	117	115	112	119	111	111
1934	...	...	114	112	108	111	112	110
1933	...	...	107	106	102	103	102	100
1932	...	...	122	117	113	117	115	111
1931	...	...	130	126	123	123	122	123

The figures for each month of the current year are higher in all but one instance than any of the corresponding months of the preceding four years, and if allowance be made for payments under the Wheat Act, 1932, and the Cattle Industry Act, 1934, the level is near, though not equal to, that of 1931. These additional payments raise the monthly index numbers by about 5 points, so that, for example, the figure of 116 for June, 1936, is increased to 121 as compared with 123 in 1931. The exceptionally high figure for April, 1936, was due to the postponement of the seasonal fall in milk

prices till the following month, which threw the index out of relation to the base.

The calendar year index for 1935 and preceding years is given below, together with the revised index which makes allowance for the additional payments referred to above. It is interesting to note that when these wheat and cattle payments are taken into account, the annual index for 1935 is raised to 123, at which level it exceeds the index number for 1931.

		1930.	1931.	1932.	1933.	1934.	1935.
General index	...	134	120	112	107	114	117
Revised index	...	—	—	114	111	119	123

The Ministry of Agriculture has also published annual index numbers of the prices of feeding stuffs and fertilizers in 1935, which show a slight decrease as compared with the preceding year, feeding stuffs standing at 87 as compared with 91, and fertilizers at 88 against 90. In 1931, these indices were respectively 83 and 96 on the base 1911-13 = 100.

Assuming that these figures can be regarded as giving some indication of the relative farming position in 1935 as compared with what it was in 1931, it appears that the prices obtained for agricultural produce (including the wheat and cattle subsidies) were, on the average, slightly higher (123 in 1935 against 120 in 1931), while the prices paid by farmers for feeding stuffs were 4·8 per cent. higher and for fertilizers about 8·3 per cent. lower.

2. OTHER STATISTICS.

The index numbers of wholesale prices prepared by the *Economist*, the *Statist* and *The Times* for the three months March to May, 1936, show a decline varying from 1·3 to 1·7 per cent., both food and materials taking part in the fall, though not to the same extent. The index numbers are taken at the end of each month, and this may to some extent account for the trend being different from that of the Board of Trade Index Number, which shows hardly any change. During May food prices and those of certain materials showed some tendency to decline. The official index numbers of wholesale prices for France, Germany, and the United States and the British Index numbers are given below, prices for 1913 being taken for all the numbers except that of the Board of Trade.

Date.	Board of Trade 1930 = 100.	Econo- mist.	Statist.	The Times.	France (Stat. Générale).	Germany (Stat. Reichs- bank).	United States (Bureau of Labor).
Feb. 1936	91.7	97.5	102.0	106.4	377	103.6	115.1
March "	91.7	97.5	101.6	105.8	379	103.6	113.6
April "	91.9	97.5	100.9	106.4	374	103.7	113.5
May "	91.9	96.0	100.2	105.0	377	103.9	112.3
May 1935	88.3*	94.3	100.2	103.0	353	100.8	114.9

* Revised figure.

There was some setback in March, 1936, to the fairly continuous appreciation in *Stock Exchange Securities* over the five months October, 1935, to February, 1936. The setback was common both to fixed interest stocks and variable dividend securities, but was proportionately greater in the latter, and was no doubt due, partly at any rate, to disturbed political conditions. The fall, however, was more than recovered in the following month, when the *Bankers' Magazine* index number (Dec., 1921 = 100) stood at 130.1, a figure higher than at any time since the index number was started in January, 1922. Some reaction took place in May both in British Government Securities and in industrial shares, but the fall was not sufficient to counteract all the previous month's advance. During the three months March to May there have been declines in value in iron and steel shares (8 per cent.), United States and Foreign railway shares (11 per cent.), copper mining shares (17 per cent.) and in tea, rubber and some other industrial and commercial shares. On the other hand, the values have advanced of oil shares, British railway stocks (both ordinary and prior charge) and South African gold-mining shares.

The index numbers (Dec. 1921 = 100) for the four months February to May, 1936, are given below.

Date.	Fixed Interest Stocks.	Variable Dividend Securities.	Total.
Feb. 18, 1936	131.0	126.7	129.6
March 19, "	130.2	125.2	128.6
April 18, "	131.5	127.1	130.1
May 19, "	131.1	124.8	129.1
May 20, 1935	131.3	114.4	125.8

There was some improvement in *shipping freights* during the three months March to May, 1936, compared with the prices ruling in February. Rates have not, however, yet returned to the high level in the last quarter of 1935. According to the index number of freight rates prepared by the Chamber of Shipping, there was a rise of 15·5 per cent. in May, 1936, compared with the figure for a year ago and some improvement was shown in all waters. There has been a somewhat better demand from South American ports than in the early months of the year, and rates are nearly 10 per cent. above those of May, 1935. The index numbers (average of 1920 = 100) for the months of March, April and May were 20·87, 20·08 and 20·70 respectively. Rates in May were nearly 16 per cent. above the level of May, 1935.

According to the Statistics of *retail sales* in Great Britain prepared by the Bank of England and the Association of Retail Distributors, there was an increase in the value of *retail* sales in May, 1936, of 7·2 per cent. over those in May, 1935, following on increases of 7·9 per cent. and 5·0 per cent. in March and April. Owing to the incidence of the movable holidays in the first half of each year, the changes from month to month are apt to be somewhat difficult of interpretation. Taking the four months February to May, 1936, together, the total sales were 6·9 per cent. above those for the corresponding period 1935, food and perishables showing an increase of 8·3 per cent. and other merchandise 5·3 per cent. Increases were highest in the South of England (8·3 per cent.) and in Suburban London (8·0 per cent.) and lowest in Central and West-End London (2·5 per cent.). On the basis of the average daily sales in 1933 being equal to 100 the daily sales for the latest months are : March, 1936, 108, April, 117, and May, 118, compared with 100, 111 and 110 in the corresponding months of 1935.

There was a decline during the three months March to May, 1936, in the numbers registered at the Employment Exchanges in the Irish Free State, from 141,858 at the end of February to 109,185 at the end of May, but this is not to be taken as evidence of any considerable improvement in employment. The reduction in numbers is stated to be due to the coming into force of an Order issued under the Unemployment Assistance Act, 1933, the effect of which is to restrict during the months March to October, 1936, eligibility for unemployment assistance of certain classes of persons living in rural areas.

Employment in Germany improved considerably in the first five months of 1936, the numbers recorded as unemployed dropping from 2,515,000 at the end of February to 1,491,000 at the end of May, 1936. Of these 246,000 were in receipt of poor relief and 842,000 in receipt of either standard or emergency unemployment benefit. A year ago the number unemployed was 2,019,000. In France employment has increased and the figures of the official special inquiry have shown an improvement month by month compared with a year ago. The numbers on the registers of Employment Exchanges also show some reduction, having fallen steadily from the end of February, but these figures are not a complete index of unemployment. In the Scandinavian countries employment has improved to an appreciable extent, and is better than a year ago. The improvement on the whole, is somewhat greater in Denmark than in Sweden and Norway. In Austria, Poland and Czechoslovakia there has been some marked improvement, partly seasonal, since the end of 1935, but in Poland it is still not so good as a year ago. In Belgium and Holland there is slight change, but in Belgium employment is better than in 1935. As regards the United States, although the amount of employment obtainable has increased considerably the numbers out of work remain very large. In Canada the spring increase in employment has been on a fairly satisfactory scale.

CURRENT NOTES.

VARIOUS considerations, some accidental, have prevented an earlier reference being made to the second Conference of Government Statisticians, which was held at Ottawa in September-October, 1935, and an attempt must now be made to remedy this apparent neglect. There were 17 delegates, including 7 from the United Kingdom, 3 from Canada, and one each from Australia, New Zealand, Union of South Africa, Irish Free State, Newfoundland, India, and (as an observer) the Imperial Economic Committee; 10 out of this number, it may be noted, are Fellows of this Society. The wide scope of the work undertaken by the Conference may be seen from the fact that the delegates in 20 committees dealt with agriculture, fisheries, forestry, mining, industrial production, uniformity of statistical classification, classification of commodities in trade statistics, gold movements in international trade, source of imports and destination of exports, valuation of imports and exports, balance of international payments, index numbers of the prices and volume of external trade, wholesale prices, retail prices and cost of living, labour, road transport, tabulating machinery, Empire broadcasts, power, and Report. Several important departments of statistics, such as vital, educational, and judicial statistics were not handled, but perhaps these are subjects for specialist conferences rather than a general assembly, the members of which were, as the above list shows, occupied as officials in dealing with production, trade, and labour. Still it is a pity that financial statistics were not treated except in the case of gold movements.

It would be impossible here to summarize the 109 resolutions with which the labours of the Conference were concluded. Many of them were aimed at securing the greatest amount of uniformity practicable at present in imperial statistics. Complete uniformity is impossible, since the countries of the Empire represent "widely different natural conditions and different stages of social and economic development," but the Conference has indicated the lines along which further progress may be made in the future. Account has also been taken of the high degree in which economic problems now dominate politics, and under the headings of consumption of foodstuffs, censuses of production, international indebtedness and payments, unemployment, wages, retail prices, and cost of living, valuable suggestions are made for the obtaining of new and comparable statistics which may throw further light on those problems. "Moreover," says the Report, "a new social and economic problem,

involving an appalling toll of human life, has been presented by the rapid development of road transport. . . . This requires knowledge for its solution. The pooling of Empire experience in this new field of statistical technique has been of the greatest value, and the Conference trusts that the detailed resolutions adopted may assist in the development of road transport statistics on uniform lines, not only within the British Commonwealth but in all countries of the world."

Enough has been said to show that this four weeks' Conference was an event of first-rate statistical importance. The resolutions speak for themselves, but there are other intangible results. First comes the greater knowledge of each others' problems and difficulties which the delegates gained in the course of their discussions. Secondly, the Report should dissipate any lingering suspicion that Government officials are obstructive and obscurantist; that is patently untrue of statisticians at least. The Report, we may add, is published by the Government printers at Ottawa.

Among League of Nations publications in 1936 may be noted *Public Finance 1928-35* (Unwin, 15s.). The Economic Intelligence Service has prepared a series of quarto reports (collected in a portfolio) on the finances of the countries of the world, to number in all 62, of which 15 are now in hand. The report on the United Kingdom, for example, covers 12 pages, and consequently the information is very compressed, but there is a sufficiency of explanatory notes, and a short list of official documents, so that there is probably enough for the reader making a preliminary survey and not a detailed study. Mr. Condliffe's *World Economic Survey 1934-35* (pp. 310, 6s.) is the fourth of an annual series, and covers the movement of prices, agriculture, industrial recovery, improvement in wages, reorganization of international trade, expanding credit, and the situation in July, 1935. The sixth volume (pp. 119, 3s. 6d.) of a collection of international agreements, etc., on *Double Taxation and Fiscal Evasion* was published in March, 1936. Finally, students of international payments will be interested in a report by the Economic Committee entitled *Survey of Tourist Traffic, considered as an International Economic Factor* (pp. 4), including the conclusions reached by a sub-committee of experts. One trusts that the estimates of the financial results of the tourist traffic are in every case sound.

It would require a *Journal* by itself to keep pace with the publications of the International Labour Office. For the convenience of Fellows there follow bibliographical details of some documents issued

in 1935 and 1936 which it has not been possible to notice earlier: *The Rural Erodus in Czecho-Slovakia*, by Dr. H. Böker and F. W. von Bulow (1935, pp. iv + 170, 5s.); *Three Sources of Unemployment*, by W. Woytinsky (1935, pp. viii + 126, 5s.); *Problems of Vocational Guidance* (1935, pp. iv + 183, 5s.); *Recreation and Education* (1936, pp. viii + 151, 4s.); *International Survey of Social Services* (1936, pp. xv + 710, 15s.); *Migration of Workers* (1936, pp. iv + 205, 6s. 6d.). The first of these reports is a study of migration from the country to the town, seasonal migration in agriculture, and emigration. The forcing of industrial development has increased internal migration, and the balance between agriculture and industry is far from stable. The problem is serious on account of the high birth-rate. There is a sufficient statistical apparatus appended to the report. Professor Woytinsky deals with the combined action of population changes, technical progress, and economic development on employment and, according to the preface, has suggested "an ingenious solution" of the "delicate problem" of "isolating technical improvements from the innumerable other factors affecting their total volume of employment." The statistics of Great Britain, Germany, France, and other countries are examined with this object, but until the new methods have been tested by further experience it may be wise to retain a reasonable amount of scepticism. The next two reports are sufficiently described by their titles. *The Survey of Social Services* is a second edition of a report issued in 1930, and this volume is a collection of summary monographs on those services in nineteen countries; another volume will include a further nineteen. Each monograph is divided into four sections, covering population, social insurance, social assistance, housing, family allowances, holidays with pay. This is a very useful handbook. The report on migration deals principally with workers' migration, and in particular with the conditions of recruiting and placing in employment.

The Report on the World Consumption of Wool, 1928-1935 (H.M. Stationery Office, 4s. net) is a valuable addition to the publications of the Imperial Economic Committee. It brings together much information in regard to the consumption and trade in wool and wool products in the different countries of the world, which was previously available only in a very scattered form. Much of the material is, of course, mainly of importance to those engaged in the industry, but some features of the trade to which the Committee draw attention are of general interest. International trade in wool products has been considerably reduced in recent years, and countries such as France, Czechoslovakia and Belgium, which are equipped for

a large export trade, are seriously handicapped. In the case of Germany and Italy, stringent import control is resulting in the increased use of wool substitutes, and mixtures with other fibres and recovered wool. At the same time, the Committee state that the increasing wool production of the world is still going into consumption, and even difficult seasons have ended with comparatively small stocks. This healthy statistical position seems due to relatively low prices which has encouraged consumption, and to the maintenance of activity in the United Kingdom which utilizes about one-fifth of the world production. Other factors have been the increased consumption in national industries in small countries, and fashion changes in the East, particularly Japan and China.

The twenty-fifth annual edition of the *International Yearbook of Agricultural Statistics* (1934-35), recently issued by the International Institute of Agriculture, Rome, does not differ fundamentally from its predecessors, though a number of additions and changes have been made with the object of making this valuable statistical record as complete as possible. It is, of course, essentially a compilation of the figures published or supplied by the different countries of the world. What may be called the agricultural statistics proper are given in two forms: first, separate tables for each country (55 in all) show the area devoted to the various crops, the numbers of live-stock, and the respective production, including, where available, live-stock products, such as meat, milk, etc.; secondly, these particulars are brought together in separate tables for each product (e.g., wheat, cotton, rice, etc.), so as to show world areas and a production and number of live-stock.

Another large section deals with international trade, and gives imports and exports of the various agricultural products, which make up a long list, ranging from wheat to bananas, tea, oilseeds, copra and rubber. Under the heading of prices are given quotations for the chief products at leading markets, and also index numbers relating to agriculture. There are now no less than 28 series of these available, and though they are not constructed on uniform methods so as to be fully comparable, they afford a useful indication of price changes in the different countries. Other tables relate to rates of exchange, production and trade in fertilisers, and the distribution of agricultural holdings. On the whole, this massive volume of 860 pages may fairly claim that it gives a most exhaustive statistical view of the world's agriculture.

We are asked to give publicity to the following announcement relating to the Bureau of Human Heredity.

The object of this Bureau is collection on as wide a scale as possible of material dealing with human Genetics. Later, the tasks of analysis and distribution of the information available will be added. The Bureau is directed by a Council representing medical and scientific bodies in Great Britain. It is affiliated to the International Human Heredity Committee, which ensures co-operation in all areas where research is proceeding.

The Council would be grateful to receive all available material from Institutions and individuals furnishing well-authenticated data on the transmission of human traits, whatever these may be. Pedigrees are particularly desired; twin studies and statistical researches are also relevant. As research workers and others who send in material may in some cases wish to retain the sole right of publication (or copyright), those who so desired are asked to accompany their material with a statement to that effect.

Material should be given with all available details in regard to source, diagnostic symptoms, and the name and address of the person or persons who vouch for accuracy. All such details will be regarded as strictly confidential.

Reprints of published work would be most acceptable. Further, many authors when publishing material may also have collected a number of pedigrees which they have been unable to reproduce in detail. It is the object of the Council that such records, by being included in the Clearing House, should not be lost.

Those wishing for a copy of the Standard International Pedigree Symbols may obtain one from the office.

Announcements in regard to the services undertaken by the Bureau will be published from time to time.

Chairman, R. Ruggles Gates.

Executive Committee. R. A. Fisher, J. B. S. Haldane, E. A. Cockayne, J. A. Fraser Roberts, L. E. Halsey (Hon. Treasurer), C. B. S. Hodson (Hon. Gen. Sec.), 15, Gower Street, W.C.1.

News of the tragically sudden death of Edgar Sydenstricker, Scientific Director of the Milbank Memorial Fund, New York, and a Fellow of the Society since 1929, will have profoundly shocked his many friends in this country. A comparatively young man—barely 55 years of age at the time of his death—Sydenstricker's interests and activities in the medico-statistical field had, neverthe-

less, earned for him wide recognition and distinction in his own and in other countries.

Appointed Statistician in 1915, and Chief Statistician in 1919, in the United States Public Health Service, his own studies and the special sanitary and disease surveys in collaboration with such workers as Warren, Frost, Goldberger, Collins, Britten, and other associates, became widely known and extensively quoted both in America and in countries abroad. In 1923 Sydenstricker was specially granted a year's leave of absence from the Public Health Service in order to undertake the organization of a medico-statistical and epidemiological department of the Health Section of the League of Nations, and it was during this period perhaps that he and his work became more intimately known and appreciated by his European colleagues. On his return from Geneva, and while still retaining his official appointment in the Public Health Service of the United States, in 1925 he accepted an invitation to act as Statistical Consultant to the Milbank Memorial Fund. In this capacity the value of his expert advice and inspiration were regarded so highly that in 1928 he was persuaded to accept a full-time permanent appointment as Director of Research, a title he retained until 1935 when he was appointed Scientific Director in charge of the administrative services of the Fund. There is little doubt that the wide range of public health studies he initiated or directed between 1925 and the time of his death were largely instrumental in persuading Federal Authorities in the United States to expand their Public Health programmes and to devote greater attention to the problems of disease prevention.

Limits of space prohibit reference to his published papers, a mere list of which would be lengthy, but no appreciation of Edgar Sydenstricker would be complete without brief mention of the intensely humane and lovable qualities which characterized his attractive personality; his gentleness, sympathy, and quiet enthusiasm and interest in all that concerned the well-being of his fellow-men were but some of the attributes which endeared him to all who enjoyed the privilege of knowing him.

OBITUARY.

SIR ALFRED WILLIAM WATSON, K.C.B., F.I.A., 1870–1936.

ALFRED WILLIAM WATSON, who died on the 7th May, 1936, was born on the 11th March, 1870. He was educated at Nottingham High School, and when he left school he went into the office of his grandfather, who was a consulting actuary with a large practice among Friendly Societies—a noteworthy survivor of the old school of actuary with no professional degree, but a wide experience and great common sense. Encouraged by his grandfather, Watson joined the Institute of Actuaries, and became a Fellow in 1893. From then onwards his success was cumulative. The family practice, including as it did the Manchester Unity of Oddfellows, gave Watson a wide experience, and he acquired a thorough knowledge of Friendly Societies, provident institutions, etc., and developed a skill in dealing with the kind of actuarial problem involved second to no one in the profession. Working, however, primarily in Nottingham, and notwithstanding his service on Lord Rothschild's Committee on Old Age Pensions, Watson was at first little known to his brother actuaries, but a paper in 1900 dealing with the analysis of the experience of Friendly Societies, with examples drawn from the Manchester Unity, and his comprehensive book published in 1902, giving the best tables for Friendly Society work that had been produced, made his name familiar to actuaries all over the world. In this great piece of statistical research Watson showed the effect of occupation and of geographical locality on rates of sickness and mortality, and accentuated the importance of bearing these factors in mind when dealing with Friendly Society finance. Watson moved his headquarters to London in 1910, and a few years later, when the National Insurance Bill became law, he was asked by the Government to become Chief Actuary to the National Health Insurance Committee with the main responsibility for the financial arrangements of the new measure. It was, indeed, a wise appointment, though, at the time, some of Watson's friends wondered if work as a civil servant would suit a man who had, all his life, been his own master with the freedom that a consulting practice might be supposed to give. Moreover, we thought that, taking a long view, Watson was making a sacrifice from the mere monetary point of view. Watson's attitude was, I think, that there was a task to be undertaken for the good of the community and it was his duty to do it. His mastery of his subject, his shrewdness and his capacity

to fit in with those with whom he came in contact led to an expansion of his official duties, and to all intents and purposes he was "Government Actuary" before he was given that title in 1917. From the time when first appointed to Government service, Watson built up a strong Government actuarial department, and the country will reap the harvest of his wisdom for many years to come.

As already indicated, Watson was best known at first in connection with Friendly Societies, and his papers and lectures made an almost complete text-book on the subject. He published further work on this subject after the War, when he had to consider the effect of changed conditions on the National Insurance Act. The statistical aspects were dealt with in this *Journal* (Vol. XC, pp. 433-473) in a paper which examined the sickness rates for men and women, duration of sickness, seasonal fluctuations in sickness, maternity benefit, and so on. Watson used a sample experience, and explained that a random sample was impracticable; instead "a more or less selective method must be used, reliance being placed on the skill and care of the operator to ensure that his data are representative and unbiased. In the case under notice some twenty societies were taken, in respect of each sex . . . chosen that their benefit expenditure when brought to a single total was . . . in agreement with the general average. . . . Further, it was regarded as essential that the membership of the selected societies should be well distributed geographically over Great Britain, and should be well mixed from the point of view of occupation." The remark is quoted to indicate Watson's statistical attitude.

Watson was called upon to examine the mortality for England and Wales when the censuses of 1921 and 1931 became available. It had become usual to base rates of mortality on the ratio between the deaths between two censuses and a mean calculated from those censuses. The War had made this method useless in 1921, and the English Life Table No. 9 was based on the 1921 census and the average of three years' deaths. Watson's experience of the mortality of members of Friendly Societies suggested a subdivision of the country into areas showing variations in mortality, the highest being the Northumberland and Durham Urban Districts, and the lightest the Eastern Counties Rural Districts. It came as a surprise to many statisticians to know the extent to which mortality varied, and I remember remarks such as "Can those extreme variations be possible? Is there a statistical fallacy?" But the more the work was examined the more convincing it became, and the results are confirmed by the similar investigation carried out for the 1931 census and published shortly before Watson's death. In these two studies Watson made use of simple methods, and did not run

the risk of confusing the issue by modifications of this simplicity: he was content to assume that the census figures gave a sufficiently accurate mean population, though the date of the census was some days removed from the middle of the period to which the deaths related. The population was varying little, and it was almost as likely that error could be introduced as that it could be removed by a modification. This gives a good example of Watson's statistical sense. He would examine the details, estimate the errors that might be involved, and then discard the unessential, accepting with delight any simplification that he could justify.

In connection with the Welsh Church Act 1914, Watson had to make a forecast of the mortality of the clergy, allowing for probable future improvements in their already light rates of mortality, and a somewhat similar task was necessary in 1923, when, with Mr. H. Weatherill, the increasingly light mortality experience of Government annuitants had to be considered in its practical aspects. The reports on the basis of unemployment insurance and on pensions, and his work as statistical adviser to the Ministry of Shipping during the War, are also well known, while special mention may be made of his Chairmanship of a departmental committee on the collection of statistics and their presentation to the public, which led to the appointment in 1921 of a standing Permanent Committee on Official Statistics, of which Watson was Chairman.

No memoir of Watson would seem to me complete if it did not mention his dislike of the so-called safe-side estimate, which, as he often said, necessarily carried a dangerous side with it. He held strongly that estimates must be as exact as they can be made on the available information, and a considered, not a fancy, margin should be taken to cover any disturbing factor.

Watson never considered himself a mathematician, and used comparatively simple devices to help him to see his way through a complicated mass of figures. His skill in this respect was remarkable, and was partly due to long and varied experience, but behind it lay an acute statistical, or arithmetical, sense which was the admiration and envy of his more mathematical friends.

From Watson's record, of success, influence and output of work, those who did not know him might imagine him as a man of commanding presence and an iron constitution. He was, however, short, almost insignificant; he had never been robust, and in the last ten years of his life he worked in persistent ill-health. His success was helped, however, by an attractive personality that won him friendship and affection, while his ability won admiration and respect. I have seen Watson at committees, where he was little known to the other members, take his seat and be content

to listen; then making his first remarks to his pipe rather than to the committee, he would deal quietly with a point or put some question leading to the root of the matter, and steadily win confidence all round. Wherever he had become well known, the moment he came into a room there was a feeling of welcome in the air.

He was a great actuary who loved his profession as few have ever loved a profession; he was a great public servant. It is not as either that we who knew him best will remember him: it will be as a friend.

W. P. E.

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Le Assicurazioni Sociali, March-April, 1936—La previdenza mutualistica per le malattie in agricoltura: *Aldo Buffa*. Statistica e medicina: *Giovanni l'Eltore*. [A Supplement contains these articles in French.]

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 Kritische Betrachtungen über die Sterbeziffer der stationären
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 Rahmen der modernen Wirtschaftsentwicklung: *A. Wilhelm*.

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International Labour Review—

- May, 1936—*The economic and social situation of Uruguay: *C. Charlone*. The present status of economic planning, I: an international survey of governmental economic intervention: *P. W. Martin*. The Levant States under French Mandate and problems of emigration and immigration: *M. Berenstein*.
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LIST OF ADDITIONS TO THE LIBRARY.

Since the issue of Part II, 1936, the Society has received the publications enumerated below :—

I.—OFFICIAL PUBLICATIONS.

(a) United Kingdom and its several Divisions.

United Kingdom—

Agriculture and Fisheries, Ministry of—

Bulletin No. 87. Beans. By A. H. Hoare. 69 pp. 2s.

Report of the Committee of Investigation for England on complaints made by the Central Milk Distributive Committee and the Parliamentary Committee of the Co-operative Congress as to the operation of the Milk Marketing Scheme 1933. 93 pp. 1s. 3d.

Sea-fish Commission for the United Kingdom, Second report. The white fish industry. 113 pp. 2s.

[London: H.M.S.O., 1936. 9½" × 6".]

Colonial Office—

Mui-tsai in Hong Kong: report of the Committee appointed by His Excellency the Governor Sir William Peel. London: H.M.S.O., 1936. 9½" × 6". 83 pp. 1s. 3d.

General Register Office—

Census of England and Wales, 1931. County of Norfolk (Part II). 26 pp. 1s. 3d. County of Nottingham (Part II). 15 pp. 1s. Wales (excluding Monmouth) (Part II). 47 pp. 2s. 6d. London: H.M.S.O., 1936. 13" × 8½". 3 parts.

Health, Ministry of—

Local Government and Public Health Consolidation Committee. Draft of a public health bill prepared by the Committee. xx + 199 pp. 3s. 6d.

—Second interim report. 134 pp. 2s.

[London: H.M.S.O., 1936. 9½" × 6".]

Health, Department of, for Scotland—

Housing overcrowding survey: summaries of reports and building proposals by local authorities in Scotland . . . Edinburgh: H.M.S.O., 1936. 9½" × 6". 15 pp. 3d.

Home Office—

Departmental Committee on Coroners, Report. 76 pp. 1s. 3d.

Departmental Committee on the Social Services in Courts of Summary Jurisdiction, Report. viii + 182 pp. 3s.

Royal Commission on Tithe Rent-charge in England and Wales, Report. 107 pp. 2s.

[London: H.M.S.O., 1936. 9½" × 6".]

Imperial Economic Committee—

Grain crops: a summary of figures of production and trade relating to wheat, wheat-flour, barley, oats, maize, and rice . . . 66 pp. 2s. 6d.

World consumption of wool 1923–1935. An analysis of consumption and trade in wool and wool products in the Empire and foreign countries . . . 306 pp. 4s. 6d.

[London: H.M.S.O., 1936. 9½" × 7½".]

Imperial Institute—

Mineral Resources Department—Mining royalties and rents in the British Empire. London: the Institute, 1936. 9½" × 6". 183 pp. 3s. 6d.

India Office—

Government of India Act, 1935. Indian financial enquiry. Report by Sir Otto Niemeyer. London: H.M.S.O., 1936. 9½" × 6". 27 pp. 6d.

(a) United Kingdom and its several Divisions.

United Kingdom—Contd.

Industrial Health Research Board—

Reports:

73. The acquisition of skill: an analysis of learning curves. By *J. M. Blackburn*. iv + 92 pp. 1s. 6d.

74. The prognostic value of some psychological tests. By *E. Farmer* and *E. G. Chambers*. iv + 50 pp. 9d.

75. Sickness absence and labour wastage. Part I. By *May Smith* and *Margaret A. Leiper*. Part II. By *Major Greenwood* and *May Smith*. v + 70 pp. 1s. 3d.

[London: H.M.S.O., 1936. 9 $\frac{1}{4}$ " x 6".]

Labour, Ministry of—

Commissioner for the Special Areas (England and Wales), Second report. vi + 120 pp. 2s.

Unemployment Assistance Board, Report for the period 31st December, 1935. 309 pp. 4s. 6d.

[London: H.M.S.O., 1936. 9 $\frac{1}{4}$ " x 6".]

Overseas Trade, Department of—

635. Finland 1935. 68 pp. 1s. 3d. 636. Estonia. Dec. 1935. 31 pp.

9d. 637. Netherlands East Indies 1933-1935. 122 pp. 2s. 638.

Dominican Republic and the Republic of Hayti. Feb. 1936. 62 pp.

1s. 3d. 639. Argentine Republic. April 1936. 84 pp. 1s. 6d. 640.

Switzerland. March 1936. 64 pp. 1s. 3d.

[London: H.M.S.O., 1936. 9 $\frac{1}{4}$ " x 6".]

Permanent Consultative Committee on Official Statistics—

Guide to current official statistics of the United Kingdom. Vol. 14, 1935.

London: H.M.S.O., 1936. 9 $\frac{1}{4}$ " x 6". 365 pp. 1s.

Select Committee on the Civil List, Report from, together with the proceedings of the Committee and an appendix. London: H.M.S.O., 1936. 9 $\frac{1}{4}$ " x 6". 43 pp. 9d.

Trade, Board of—

Statistical abstract for the United Kingdom . . . 1913 and 1921 to 1934.

Seventy-ninth number. London: H.M.S.O., 1936. 9 $\frac{1}{4}$ " x 6". xv + 436 pp. 6s. 6d.

Scottish Office—

Committee of Investigation for Scotland on complaints made by representatives of milk distributors on the Permanent Joint Committee appointed under the scheme as to the operation of the Scottish Milk Marketing Scheme 1933. London: H.M.S.O., 1936. 9 $\frac{1}{4}$ " x 6". 16 pp. 4d.

(b) Dominions, Colonies, and Protectorates.

Ceylon—

Sessional papers, 1935: XXII. The Ceylon malaria epidemic 1934-35.

Report by the Director of Medical and Sanitary Services. 96 pp. Supplement, 20 maps + 8 charts.

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(c) Foreign Countries.

Czechoslovakia—

Office de Statistique—

Recensement des exploitations agricoles . . . d'après l'état au 27 mai 1930. Tome III. Partie 2. Moravie et Silésie. Prague, 1935.

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Denmark—

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Italy—

*Istituto Centrale di Statistica—*Annali di statistica, Serie VI. Vol. XXXV. Atti del Consiglio Superiore di Statistica sessione ordinaria 20 dicembre 1935. 106 pp. L. 10.
— Vol. XXXVI. Le variazioni dei salari agricoli in Italia dalla fondazione del Regno al 1933. Prof. P. M. Arrari. xx + 754 pp. L. 40.
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*Departement van Economische Zaken—*Census of 1930. Vol. V. Native population in Borneo, Celebes, the Lesser Sunda Islands and the Moluccas. Batavia, 1936. $13\frac{1}{2}'' \times 9\frac{1}{2}''$. xiii + 239 pp.

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JOURNAL

OF THE ROYAL STATISTICAL SOCIETY

PART IV, 1936.

THE INFLUENCE OF THE PRICE LEVEL ON THE HIGHER INCOMES.

By SIR JOSIAH STAMP, G.C.B., G.B.E., F.B.A.

[Read before the ROYAL STATISTICAL SOCIETY, May 19th, 1936, the PRESIDENT,
PROFESSOR M. GREENWOOD, F.R.S., in the Chair.]

I. *The Broad Issues.*

ON a crude view of the quantity theory of money, if the purchasing medium were doubled overnight, and perfect mobility existed for the prices of goods and services of all kinds, which in themselves were unchanged in volume and character, all prices and rewards would be expressed in double the amount of money, everyone would have a doubled money income, but an unchanged real income. The *relative* distribution of incomes would be unchanged. But measured against a fixed scale of money incomes, the statistics of incomes might be rather difficult to read intelligently. Suppose we had the following scale of original incomes which, though hypothetical, is conformable to actual type :—

	Amounts.				No. of Incomes.	
Over	£100,000	...	...	...	...	100
Between	50,000	and £100,000	...	...	...	250
"	25,000	" 50,000	...	...	...	1,000
"	10,000	" 25,000	...	...	...	6,000
"	5,000	" 10,000	...	...	...	16,500
"	2,500	" 5,000	...	...	...	46,000

After the overnight change in the price level this would read :—

Over	£200,000	...	...	...	...	100
	100,000	to £200,000	...	...	...	250
	50,000	" 100,000	...	...	...	1,000
	20,000	" 50,000	...	...	...	6,000
	10,000	" 20,000	...	...	...	16,500
	5,000	" 10,000	...	...	...	46,000
	2,500	" 5,000	...	...	...	?

It would be seen that whereas the £50,000 to £100,000 class is four times its former magnitude, the £10,000 to £50,000 class is only 3·2 times the former numbers, and the £5,000 to £10,000 is 2·8

times. At first sight we might declare that each income class ought to have gone up equally.

It may be seen that to set against a range of fixed distance measuring points, a new range of quantities in which the differences have doubled, and which, therefore, stretches over twice the total distance, is to get a false sense of the change that has taken place. It is like setting at the side of a wooden foot-rule an elastic foot-rule, which has been *stretched to twice its normal length*. If they are put level at the beginning, the double distance of the first inch is a different thing altogether from the double distance at the tenth inch, and in connection with comparing fixed scales it is necessary to bear this in mind all the time. Logarithmic spacing may correct this false impression, and that is why the Pareto index scales are the most suitable for registering such changes. On such scales we can just lift the income pyramid bodily for the required distance without changing its shape. Represented graphically, as one side of a pyramid, we might put it thus:—

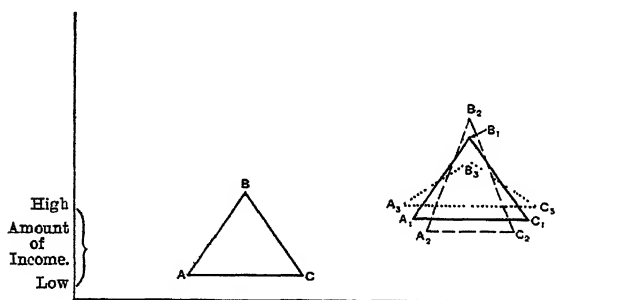


FIG. 1.

The pyramid ABC represents the numbers in the classes of incomes at a certain level of price, such that the few at the apex B have the high incomes and the many along the base the lowest. At the second and higher level of prices, the original number AC have higher money incomes and all the others to correspond. Is the new pyramid the same shape $A_1B_1C_1$ or does it undergo elongation, $A_2B_2C_2$, or compression $A_3B_3C_3$, in the process of being lifted?

But, in fact, changes in price levels are very different in their effects in practice. Even if goods and services are unchanged, a change in the purchasing medium will greatly affect some prices (and therefore some sales and consequently some incomes), and affect them more than others; many customary services, wages and fees with rents and obligated interest, will hardly be affected at all. The ordinary price index change may be much "livelier" than the net change in total incomes. This index change makes a real

redistribution of net money incomes as between different categories. If different categories are not proportionately distributed over different magnitudes of incomes, then it will also make a difference in the magnitude distribution. If every income were made up in equal proportions of the various elements, the net relative distribution might be unchanged; but, in fact, large incomes may be quite different in composition from small—they may contain more elements quickly susceptible of change—if wages and interest are immobile, larger incomes drawn mainly from profits may rise disproportionately on a rise of price, and fall much more heavily on a fall. In other words, on a rise of prices, the number of rich may be proportionately greater than the median, and the median than the lower incomes, or, put another way, the top *X* people may have a larger proportion of the total than before. On a further fall below the assumed norm the position may be reversed, and the top *X* people may get a much diminished proportion of the total.

But goods and services are unlikely to remain the same with a change in prices. On a rise of price they may be increased in volume through trade activity, and so tend to check the price rise resulting from a given increase in purchasing power. This effect (a new volume of goods or services multiplied by a new price) may not be proportionately spread over the whole community. Fortunately, it is no part of my purpose here to discuss why price levels change, in *fact*, and how far different renderings of the quantity theory are valid. We can start from the point that changes do actually take place, and with them some change in the amounts of incomes certainly occurs. It may very well be that the change in incomes will not be the same with a particular change of prices without regard to the way in which that particular change of prices is brought about, viz., changed volume of the purchasing medium, changed volume of goods and services, changed velocity of circulation. But the cause of the change is not determinate—we must just accept the resultant changes of price as the result of composite causes, with a modal influence upon incomes. Even if we assumed that there was an exact direct correlation between prices and incomes (other things being equal), it would by no means follow that the percentage variations would be equal, and, indeed, it is highly improbable. For, accepting the view above that some constituents of income respond rapidly and others are inert, it would be expected that the average deviation for incomes would be smaller than that for prices. If the constitution of particular classes of income corresponds with that of incomes as a whole, and if we class as “inert” the profits assessed to income tax under Schedules A, B and C (property, ownership and occupation, and income from public securities),

three-fourths of salaries under Schedule E, railway profits and interest under Schedule D, and as responsive, one-quarter of Schedule E salaries and all trading profits under Schedule D, the "inert" would be rather less than 60 per cent. of the whole (in 1933). Even exact correlation, therefore, might well be accompanied by an average deviation (in incomes) less than the average deviation in prices, and we might hazard a guess that it would be about one-half at most. On the other hand, if we took, not a wholesale price index affecting profits, but a cost-of-living index representing purchasing power of wages (with many inert items), and remember that the link between such a cost-of-living index and the high incomes must be remote both in theory and practice, we should expect the degree of correlation to be far less, but the extent of variation much closer.

* * * * *

What has happened to incomes in actual fact? Is it possible to test any of these points? A statistical graduation of income in the mass is not available in this country, but we have now for over twenty years the annual super-tax (now surtax) statistics, which at the present time give the incomes above £2,000 p.a. and began with those over £5,000 p.a. in 1911-12. (The two earlier years were given in the Statistical Tables of the Royal Commission on the Income Tax 1920, but they are omitted here in order to give the statistics an opportunity to "get into their stride.") This material, summarized in Appendix I, is the basis of the present enquiry, but it is not possible to extend the enquiry upon similar lines to the great mass of lower incomes.

II. *Tests of Relative Distributions of Income.*

Before we examine the data from different points of view, it is important to consider what tests we shall apply, because defects or peculiarities in the data will be important in some connections, but unimportant in others. For example, if we were concerned with the absolute accuracy of the data, in total, and as distributed, certain defects would be most important and certain tests paramount. But if our objective is accuracy of yearly *comparisons* only, those peculiarities, if constant in character, may be unimportant, and other tests are more appropriate.

It may be well to pass briefly in review the various devices for measuring or contrasting distribution of incomes according to size. The most familiar is, of course, "Pareto's Law" or formula, for which at one time rather formidable claims were made, but which has suffered criticism on its mathematical basis, and also, more recently, because it is said to give really a much poorer fit to the data than had been supposed. In its simplest and most categorical

expression, if the income distribution is plotted upon a double logarithmic graph with one axis representing numbers of incomes above stated amounts, and the other, those levels of income, the points will be upon a straight line, the equation being $\log N = \log A - \alpha \log x$, where x is the level of income, and N the total number of incomes of that size and more. When Pareto found that for all the statistics of modern times and countries available, the straight line was a good fit, and α was pretty constant round 1.5, he concluded that some fundamental force made incomes behave so, and therefore that the only way to improve incomes or economic welfare was by increasing production and the whole range of income, and that it was useless to depend upon the usual panacea of redistribution of incomes.

F. R. Macaulay showed that the Pareto line was nothing more than the ordinary tail of an extremely skewed distribution. But if it served for interpolation and a little extrapolation, this was not actually to condemn it for all purposes, as so many have done. But it was considered also intrinsically unlikely that the summation of a number of separate distribution curves for the different *classes* of income would give a composite result having any of the fundamental significance usually attached by Pareto to it. Personally, my instinct would be to expect that the discontinuities of sectional distributions would be generally greater than those of the aggregate. In any case, in the lower sections of income there are sometimes customary points, such as £300 or £400, which give heavy sub-modal points, intermediate salaries, etc., being found in far fewer cases. And the peculiarities of tax assessments have been responsible for the failure of the Pareto index to give results coinciding with the actual tax exemption points or statistics at other administratively critical points of the scale. I have described this phenomenon elsewhere. Apart from this, the actual points at the top tend to be on the left of the line (*i.e.*, fewer large incomes than the index for the main section would indicate), and at the bottom to the right of the line for the small incomes, much more numerous than this index would indicate. In consequence, a line joining the actual plotted distribution tends to be rather like an elongated S with a long, straight middle section. For extrapolation purposes in middle ranges it has, in my judgment, despite the criticism of extreme claims, some considerable uses, and my description of the practical use made of this gap on the inception of the super-tax was given by me some years ago, and has often been quoted.

Three recent contributions to the subject in the *Economic Journal* have challenged the goodness of fit in Indian statistics, have reinforced the value of this fit, and generally made a closer analysis

of the use of the formula. But there is little in this literature that is germane to the use that I shall make of it—limited, in fact (1), to interpolation in fairly narrow ranges, and (2) to a straight computation for comparative purposes. As a matter of fact, for this second use it tends to condense, through logarithms, and to make annual changes less visible to the eye than the other ways of treating the same statistics.

In 1931, R. Gibrat, a French writer,* suggested a modification of the Pareto idea through a normal curve of error adjusted by a selected income constant $(x - x_0)$ with the equation $y = \pi^{-\frac{1}{2}} e^{-\frac{1}{2}z^2}$ and $z = \alpha \log (x - x_0) + b$, y being the number of incomes and x the amount of income. The usual objective of these formulæ is a determinant of inequality, and with Pareto's α the higher the value the steeper is the slope, and the less the inequality. Corrado Gini has a concentration index δ similar in origin to Pareto, but involving the total amount of incomes over a certain size. It can be expressed in terms of Pareto as $\delta = \alpha (\alpha - 1)$.

Coefficients of dispersion have been used, as average or standard deviations from some mode or average. These have only a limited use for the purposes of this paper. The Lorenz method plots the cumulative percentage of aggregated incomes along the horizontal axis, so that an equal distribution gives a straight line at an angle of 45° , and the inequality is greater as the curve of actual income bulges further from this axis.

The general study of the problems suggests, first, that as there are many different questions involved in income distribution, different methods of measurement are best adapted to particular ends, and one is justified in choosing *ad hoc* by trial that method best adapted for the purpose in hand. Second, that many suppositions derived by abstract reasoning from general principles as to the behaviour of distributions under different conditions are falsified when tested against statistical data. Thus Morris Copeland in 1932 suggested that the distribution of all incomes tends to become more concentrated in years of depression and less concentrated in years of prosperity—a conclusion which has been doubted. Simon Kuznets says that "all studies tend to disregard the absolute size of incomes and study only relative inequality, although most of them note the positive correlation in time between size of average income and extent of inequality. But from the point of view of welfare, capital formation or other analytic implication of a frequency distribution of income, the absolute size of incomes involved is of material importance. Income inequality may decline during years of depression, but the welfare inequality may rise materially because

* *Les Inégalités Economiques*.

of the general lowering of the absolute level of incomes. Similarly, inequality may be more conspicuous in one country than in another, but because of difference in the absolute size of income, the capital-forming power of the second country may be greater than that of the first; that is, assuming that inequality of distribution stimulates capital formation, a rather doubtful hypothesis" (Simon Kuznets, "National Income," *Encyclopædia of the Social Sciences*). Now, except so far as a rise or fall in the price level may be closely associated with prosperity or depression, the question of the effect of the fluctuation of prices upon distribution has hardly been suggested, let alone examined.

III. Examination of the Data.

It is not possible to examine the effect of price fluctuation on less than an annual basis, because income itself is not known for a shorter period, and, in fact, the term "income" is almost meaningless in statistics save as an annual concept, and even here has severe limitations. This involves bringing the price-level indexes on to an annual basis, either by a weighted collection of annual average prices, or by an average of twelve monthly indexes. The latter is the most available method, but our *Sauerbeck-Statist* index produces its own annual figure which must serve for our purpose. (The tests I have made with other indexes make no substantial difference in the conclusions.) But I have also occasion to use the cost-of-living index, as subject to much narrower fluctuations than wholesale prices, and perhaps reflecting incomes more naturally, though least naturally the higher incomes. On the income side we have to consider the nature of the statistical material carefully from three points of view. The statistics of incomes are of legal or statutory incomes. First, how closely do statutory incomes for taxation conform to actual money incomes as commonly understood, both absolutely as to magnitude and relatively as to fluctuation from year to year? How far have there been changes of statutory bases such that there are "breaks" affecting comparisons, because incomes are differently computed in different years? Second, how far do the published statistics represent the actual statutory incomes for the periods indicated? Third, with what *actual* periods of time do the *legal* incomes correspond, and is the demarcation clear or blurred, and if blurred, how far are real fluctuations artificially smoothed out or provoked by the statistical and the statutory conditions combined? In short, under these heads have we such difficulties that comparisons of short period fluctuations are fallacious or unreliable?

(1) *The conformity of statutory assessments with actual income.* Monetary and spendable incomes, particularly in the higher stages,

tend to fluctuate much less violently than full business profits because of rents and inert items of income. Statutory profits for taxation tend to fluctuate less than real commercial profits, in so far as stock valuations make inner reserves by accountancy practice, and in so far as losses are carried forward against profits, and in so far as renewals and depreciation are allowed on a more even basis than in actual business accounts. But aggregate dividends tend to fluctuate less than either real or statutory profits because of the conservative or "steady dividend" practice of refraining from paying away full profits in good times, and making a big effort to pay dividends, if necessary, from reserve amounts carried forward in bad times. And dividends, rather than profits, count for taxation of individual incomes over the greater part of the field. Rents and salaries are hardly responsive at all to quick external fluctuations individually, though they will disappear and reappear with changes of national prosperity. But there is no reason why total statutory incomes should not approximate to total economic individual income in the long run, if perfectly assessed. (This absolute identity will not exist to the same extent with total *profits*, because of the continuous process of creating collective income in excess of distributed income, by companies with increasing free reserves—which on balance is in excess even in bad times in this country.) But fluctuations must tend to be obscured.

With imperfect assessment, or evasion, the absolute difference increases, but the fluctuations are not necessarily affected to anything like the same extent. A constant loss of, say, 20 per cent. in the aggregate, making the absolute totals unreliable, might not invalidate comparisons of fluctuations in the least. Nor need we know the precise degree of the loss. If fraudulent evasion tends to be greater where incomes are rising and less when they are falling, then this element would reduce fluctuation. But we have no evidence that this is the case, particularly for short-run comparisons. Some people are more willing to pay up to the mark when the "going is good," or they may be forced by hard times into loose consciences. Others are reluctant to show the full extent of growing good fortune. These elements would affect the fluctuations of the aggregates liable. But they would not affect the relative distribution unless the tendency to evasion is greater, *pro rata*, at some points in the scale than at others, and even then they would not affect the comparative statistical or relative distribution from year to year unless these differential tendencies were also affected, and the points of particular susceptibility to the idiosyncrasy in question tend to shift up and down the scale. Now, the moment we make comparisons of the inequality of distribution over considerable periods of time, to see whether

inequality is getting greater or less, these questions, as to whether evasion is becoming different *pro rata* at different levels, become important, and the increase or decrease of evasion as a whole is also significant, but for a year-to-year comparison of differences it is much reduced as a disturbing factor.

Similar considerations apply to legal avoidance, or the numerous devices invented to reduce liability—creation of trusts and income charges, registration of private companies abroad, etc. Do these operate to a higher proportionate extent in the higher brackets than in the lower? If the average real income of £10,000 is reduced in this way by £ x , is the £50,000 income reduced by 5 x £ or some higher amount, and the £100,000 income by 10 x £ or must we say, 20 x ? If so, then the Pareto index or slope must be definitely affected, and we may draw wrong deductions therefrom as to distribution and inequality. But it may well be that the effect is much the same most of the way down, leaving α untouched. Moreover, if the tendency greatly increased over a period of years, so long as it was still proportionately spread all the way down, then α would again, *ceteris paribus*, be unaffected. But even suppose it is quite disproportionately spread, we are at this point mostly concerned with the short-period fluctuation, and this comparison can only be vitiated if the *extent* of the disproportion changes from year to year.

(2) *The conformity of published statistics with the actual statutory incomes for the periods stated.* The statistics for a particular year of assessment are not actually complete until a full six years after, because power to assess, or to add to assessments, exists over the whole period, and adjustments are continually being made. This does not necessarily mean that we can make no use of the tables since 1928, because each year's report gives the latest figures for each of the last six years of assessment. Any given year of assessment will thus appear six times, with figures advancing in the aggregate and for each class each year. The absolute differences between the earliest and last year are, of course, important, but it does not follow that the *slope* of distribution is altered. If all the classes get the same percentage addition of new assessments every year of the six-year period, then the earliest report will be as useful as the latest. But there is a *prima facie* case for assuming that in the first years the obviously liable cases will be found and assessed, and that in the later years more and more of the obscurer cases close to the margin of liability at the bottom will be gradually traced. If so, the lower classes would be relatively deficient on the first reports, and would be increased to a much more than proportionate extent, as time allowed. This was certainly the case in the earliest days of the super-tax, and when the six-year rule did not apply. (See *Wealth*

TABLE I.
Super-tax, Year 1928-29.

Class.		As in 1921		As in 1922.		As in 1931.		As in 1934.		As in 1935.	
Exceeding :	But not Exceeding :	No. of Persons.	Total Incomes Assessed.	No. of Persons.	Total Incomes Assessed.	No. of Persons.	Total Incomes Assessed.	No. of Persons.	Total Incomes Assessed.	No. of Persons.	Total Incomes Assessed.
£	£		£000.		£000.		£000.		£000.		£000.
2,000	3,000	39,818	97,437	41,418	101,258	41,994	102,618	42,439	103,915	42,663	104,351
3,000	5,000	30,156	114,937	30,870	117,679	31,142	118,708	31,373	119,722	31,494	120,170
5,000	10,000	18,559	126,591	18,956	129,276	19,147	130,601	19,277	131,483	19,324	131,792
10,000	50,000	8,676	153,246	8,885	157,076	8,971	158,593	9,016	159,443	9,030	159,729
50,000	100,000	357	24,222	367	24,927	383	26,054	387	26,271	387	26,271
100,000		130	24,886	130	24,915	135	27,049	135	28,132	135	28,306
Total		97,696	541,319	100,626	555,131	101,772	563,623	102,627	568,966	103,033	570,619

TABLE II.
Table showing each Class Standardized on the 1931 Figure.

£	£	As in 1931.		As in 1932.		As in 1931.		As in 1934.		As in 1935.	
		No.	Income.	No.	Income.	No.	Income.	No.	Income.	No.	Income.
2,000	3,000	1,000	1,000	1,040	1,039	1,055	1,053	1,066	1,066	1,071	1,071
3,000	5,000	1,000	1,000	1,024	1,024	1,033	1,033	1,040	1,042	1,044	1,046
5,000	10,000	1,000	1,000	1,021	1,021	1,032	1,032	1,039	1,039	1,041	1,041
10,000	50,000	1,000	1,000	1,024	1,025	1,034	1,035	1,039	1,040	1,041	1,042
50,000	100,000	1,000	1,000	1,028	1,029	1,073	1,076	1,084	1,085	1,084	1,085
100,000		1,000	1,000	1,000	1,001	1,038	1,087	1,038	1,130	1,038	1,137
Total		1,000	1,000	1,030	1,026	1,042	1,041	1,050	1,051	1,055	1,054

TABLE III.
Super-tax, Year 1930-31 (being Surtax year 1929-30).

Class.		As in 1933.		As in 1934.		As in 1935.		As in 1936.	
Exceeding :	But not Exceeding :	No. of Persons.	Total Incomes Assessed.	No. of Persons.	Total Incomes Assessed.	No. of Persons.	Total Incomes Assessed.	No. of Persons.	Total Incomes Assessed.
£ 2,000	£ 3,000	44,132	£000. 107,654	45,243	£000. 110,287	45,611	£000. 111,153	45,813	£000. 111,799
3,000	5,000	32,313	122,971	32,953	125,426	33,119	126,053	33,222	126,480
5,000	10,000	19,415	132,143	19,825	134,923	19,949	135,784	19,989	136,056
10,000	50,000	9,134	159,394	9,279	161,687	9,312	162,453	9,326	162,643
50,000	100,000	379	25,810	401	27,207	400	27,218	400	27,218
100,000		144	29,342	142	29,057	141	28,865	141	28,865
Total		105,517	577,314	107,843	588,587	108,532	591,526	108,891	593,061

TABLE IV.
Table showing each Class Standardized on the 1933 Figure.

		As in 1933.		As in 1934.		As in 1935.		As in 1936.	
£	£	No.	Incomes.	No.	Incomes.	No.	Incomes.	No.	Incomes.
2,000	3,000	1,000	1,000	1,025	1,024	1,034	1,033	1,038	1,039
3,000	5,000	1,000	1,000	1,020	1,020	1,025	1,025	1,028	1,029
5,000	10,000	1,000	1,000	1,021	1,021	1,028	1,028	1,030	1,030
10,000	50,000	1,000	1,000	1,016	1,014	1,019	1,019	1,021	1,020
50,000	100,000	1,000	1,000	1,058	1,054	1,055	1,055	1,055	1,055
100,000		1,000	1,000	986	990	979	984	979	984
Total		1,000	1,000	1,022	1,020	1,029	1,025	1,032	1,027

and *Taxable Capacity*, also *Statistical Journal*, 1911, p. 200, "A New Illustration of Pareto's Law.") It follows that the statistics for any particular year should always be taken from the latest report, which supersedes all the earlier ones for that year. But the question whether we can use the uncompleted years for our survey with safety, or if not, what the extent and nature of the correction should be, can best be answered by an actual examination of a particular year for six years' statistics. The last completed one is 1928-29. The reports are reproduced in Table I, p. 636.

If we treat the first year as 1,000 in each class, the successive additions for succeeding years are shown in Table II.

It will be seen that the lowest class increased by 7 per cent. against just over 4 per cent. in the next three classes, as was indicated above. Then there was a small surge through these classes leading to an increase in the next of $8\frac{1}{2}$ per cent., and in the highest class of over 13 per cent., but, of course, this is small in absolute amount. In the aggregate the bulk of the increase 2.6 per cent. came in the second year, 1.5 in the third, 1.0 in the fourth, and 0.3 per cent. in the last. In order to see how far this result is characteristic, we may examine 1929-30 for four years, as in Tables III and IV.

Here 2.0 per cent. was gained in the second year, and it only became 2.7 by the fourth year. The same characteristic appears of a larger increase in the lowest class 3.9 than in the next three, then a larger one again in the £50,000-100,000 class, 5.5, and an actual reduction in the top class. Apparently the pattern of increase is fairly consistent except for the top class, which will, with such small numbers and special cases, always behave rather freakishly. If the index of distribution is computed by taking the top two classes together, making only four classes in all, it is probably accurate enough to say that the top and bottom gain slightly more than the intermediate classes over the whole assessable period, and that the effect upon total distribution is not very marked, while, if we compare one year with its neighbour at any stage, the differences will not be significant. Thus the decline in total numbers and amounts from 1929 to 1933, as shown in the main surtax statistics in Appendix I, cannot be due to the more complete assessment or fruition of the earlier years—it is far too great in magnitude, and will not be made good in the course of time by additional assessment.

(3) *Statutory and Administrative Discontinuity.—The Time Factor.*

(i) When the super-tax was first introduced, premiums in respect of life insurance and deferred annuities were allowed as a deduction in computing income for super-tax purposes, up to the limit of one-sixth of the total net income, and this deduction (unlike the deduction for income tax purposes) was allowed to have

the effect of reducing the income below the limit of income (then £5,000) at which super-tax began to apply. For super-tax the allowance was wholly withdrawn in 1916 (see Appendix No. 7 (f), p. 61. Royal Commission on the Income Tax, 1920). The absolute amount of incomes charged is, of course, affected, but the spread in any particular year not necessarily so, for there is a reasonable assumption that it was fairly proportionately borne all down the scale, though it is true that there was no heavy differential tax on the highest incomes then making this kind of provision exceptionally attractive at those levels, and in general the necessity for insurance was heaviest at the lower levels when earned income prevailed in salaries, etc.

(ii) The Excess Profits Duty ran from 1914 to 1920 as a deduction from profits of business for taxation to income tax, at rates of from 50 to 80 per cent. on the excess. This must have materially reduced the amount of income coming under income tax in those years and the super-tax incomes of 1915-16 to 1920-22. At the same time, it is thought to have materially enhanced the level of prices, especially towards the end. If there is an ordinary comparative ratio of variation that exists between incomes and prices, it would therefore tend to be greatly widened during this period, and reference to the various tables and graphs given in this paper shows that to have happened. Prices in 1920 rose immensely more (per cent.) than incomes. But in general there is no evidence to rebut the presumption that the incidence of the deduction of excess of profits duty was proportionate down the scale.

(iii) From 1922 special legislation was introduced to deal with the non-division of the profits of small private companies, and where restricted dividends were being paid, to ignore these and divide up the whole profits for super-tax purposes. This may have been a material element in increased assessments from that date. There was also legislation for dealing with revocable dispositions to members of the family, etc., which has strengthened the assessments, but so far as the declaration of bonus dividends in ordinary companies is concerned, the Case law, as a whole, has been against the revenue contentions. It does not make a conspicuous break in the aggregate figures at any point; nor do any of these matters affect the general distribution.

(iv) In 1923-24 a serious break occurs in the severance of the Irish Free State—that is, serious if we are concerned with the aggregates of the assessments rather than their distribution. We find that in the Report of that year the aggregate for Great Britain and Northern Ireland was about £5,000,000 less than for the United Kingdom as previously constituted, or 1,111 taxpayers. But the ultimate figures for Great Britain and Ireland, as finally published, were

16,000,000 more and nearly 2,832 taxpayers, so that the check due to the break was completely swallowed up in the actual increase of assessable wealth, and it is not possible to trace any effect upon the relative distribution in the parts.

(v) In 1926-27 the general basis of the Income Tax Schedule D assessment was altered from the three years' average to the preceding year. Up to that time the profits of the years 1, 2 and 3 were averaged to make the assessment for the year 4, and this became the basis of the super-tax for the year 5. In so far as the super-tax deals with profits through dividends, the matter was not important, but no doubt some part of the figures brings in direct areas of the income tax assessment. Its final effect we cannot determine, but, once again, there is no reason to suppose that it has an important effect upon distribution.

(vi) In 1927-28 there was an important change of name from super-tax to surtax, which is rather confusing in the tables. It is described in the 71st Report, where it is stated that what is now called the surtax for 1928-29 would have been the super-tax for 1929-30. In the tables, therefore, in this paper, the surtax year has been shifted forward by one, in order to make all the years correspond to constructive super-tax years.

(vii) The most recent legislation which will have helped to support the aggregates from being depressed through legal avoidance, is that relating to life insurance payments by way of single premium policies and the interest thereon. In its influence upon the aggregates this would have a sustaining effect, but its influence on distribution is difficult to determine. I know of no evidence to show that it was more prevalent in the highest than in the lowest ranges.

The foregoing is a mere selection of the numerous points affecting the amount of assessments, and, in itself, it seems an imposing array, which might well be regarded as destroying the comparative value of the figures. If I were basing anything significant upon the movement of the aggregate sums assessed, some of them would need very close study and elaboration here, but the majority of them have, *prima facie*, no definite effect upon distribution, and, inasmuch as the figures at best cannot be absolutely sharp, through the blurring of dates, etc., this feature represents only one additional qualification. The warning, therefore, must be to allow a reasonable margin of doubt in all conclusions which depend upon fine differences.

IV. *The Behaviour of the Numbers and Amounts in Class Intervals.*

As a first approach to the examination of this material, we may consider the way in which the total numbers of incomes exceeding

a particular minimum are divided in the four main classes. Table V gives the *actual* subdivisions of the numbers over £5,000.

TABLE V.

Number of Persons in each Classification of Income, Year 1911-12 to Year 1934-35.

Super-tax year.	Total Number of Persons with Incomes Exceeding £5,000.	Number of Persons with Incomes Exceeding £100,000.	Number of Persons with Incomes Exceeding £50,000 but not Exceeding £100,000.	Number of Persons with Incomes Exceeding £10,000 but not Exceeding £50,000.	Number of Persons with Incomes Exceeding £5,000 but not Exceeding £10,000.
1911-12 ...	12,399	68		4,188 †	8,143
1912-13 ...	12,965	78		4,442 †	8,445
1913-14 ...	13,664	75		4,820 †	8,769
1914-15 ...	14,687	90	252	4,941	9,404
1915-16 ...	14,159	88	223	4,500	9,348
1916-17 ...	15,920	103	239	5,272	10,306
1917-18 ...	18,060	127	337	6,110	11,486
1918-19 ...	19,831	121	363	6,761	12,586
1919-20 ...	22,923	148	392	7,868	14,515
1920-21 ...	26,557	175	496	9,315	16,571
1921-22 ...	28,803	206	481	9,954	18,162
1922-23 ...	26,114	139	407	8,591	16,977
1923-24 ...	27,067	133	461	9,019	17,454
1924-25 ...	27,428	144	457	9,082	17,745
1925-26 ...	28,229	144	438	9,200	18,447
1926-27 ...	28,304	150	412	9,097	18,645
1927-28 ...	28,120	135	387	8,912	18,686
1928-29 ...	28,876	135	387	9,030	19,324
1929-30 * ...	29,846	166	409	9,406	19,865
1930-31 * ...	29,856	141	400	9,326	19,989
1931-32 * ...	27,302	111	350	8,167	18,674
1932-33 * ...	22,953	95	244	6,693	15,921
1933-34 * ...	20,531	84	220	5,914	14,313
1934-35 * ...	19,713	65	214	5,719	13,715

* Now described as surtax years for the years preceding these.

† Not divided officially.

Treating the aggregates in *each* year as 1,000, Table VI shows how these divisions have varied in their proportion. It will be seen that as the aggregates become greater towards 1921-22 the percentage in the lowest class (£5,000 to £10,000) steadily fell, then with the aggregate change downwards in 1922-23 the percentage of the lowest class rose sharply, and as the aggregate has fallen from 1929 the percentage in the lowest class has steadily risen.

Another way of examining the same figures is given in Table VII, where each column is turned into an index number (with base = the average of 1922-25) and the variations in magnitude of each series are strictly comparable. Thus these series can each be com-

pared with the Sauerbeck Index series in Col. 1, and the *general* correspondence of the aggregate numbers with incomes over £5,000 can be tested. The following comparisons may also be noted.

TABLE VI.

Number of Persons in each Classification of Income, Year 1911-12 to Year 1934-35.

(Table showing number of persons in each class in relation to the total number with incomes over £5,000.)

Year.	Total Number of Persons with Incomes Exceeding £5,000.	Number of Persons with Incomes Exceeding £100,000.	Number of Persons with Incomes Exceeding £50,000 but not Exceeding £100,000.	Number of Persons with Incomes Exceeding £10,000 but not Exceeding £50,000.	Number of Persons with Incomes Exceeding £5,000 but not Exceeding £10,000.
1911-12 ...	1,000	5		338 †	657
1912-13 ...	1,000	6		343 †	651
1913-14 ...	1,000	5		353 †	642
1914-15 ...	1,000	6	17	337	640
1915-16 ...	1,000	6	16	318	660
1916-17 ...	1,000	7	15	331	647
1917-18 ...	1,000	7	19	338	636
1918-19 ...	1,000	6	18	341	635
1919-20 ...	1,000	7	17	343	633
1920-21 ...	1,000	6	19	351	624
1921-22 ...	1,000	7	17	346	630
1922-23 ...	1,000	5	16	329	650
1923-24 ...	1,000	5	17	333	645
1924-25 ...	1,000	5	17	331	647
1925-26 ...	1,000	5	16	326	653
1926-27 ...	1,000	5	15	321	659
1927-28 ...	1,000	5	14	317	664
1928-29 ...	1,000	5	13	313	669
1929-30 * ...	1,000	5	14	315	666
1930-31 * ...	1,000	5	13	312	670
1931-32 * ...	1,000	4	13	299	684
1932-33 * ...	1,000	4	11	291	694
1933-34 * ...	1,000	4	11	288	697
1934-35 * ...	1,000	3	11	290	696

* Now described as surtax years for the years preceding these.

† Not divided officially.

The highest incomes have a rough general correspondence with price movements, but the fluctuations in the lowest class are much steadier as a whole, though no clearly emergent tendency appears.

The next table (VIII) shows how each year's total income "over £5,000" was divided up (in percentages) amongst the main income groups. The highest class at 10.3 per cent. of the whole in 1920-21 has fallen almost steadily to 5.1 per cent., and the lowest class rose from 32.2 per cent., its lowest point in 1920-21, to 43.0

per cent. in 1934-35. The signs of the changes in these two classes are highly correlated negatively, being definitely converse in all but five out of twenty-three cases. If we correlate the changes of sign between the price index and the incomes exceeding £100,000, they are also definitely converse in only four cases out of twenty-three. (Computations of the coefficient of correlation for the actual differ-

TABLE VII.

Number of Persons in each Classification of Income, Year 1911-12 to Year 1934-35.

(Index showing number of persons in each class standardized on average of years 1922-23, 1923-24 and 1924-25.)

Year.	Sauerbeck Index Number on Base of 1923-25.	Total Number of Persons with Incomes Exceeding £5,000.	Number of Persons with Incomes Exceeding £100,000.	Number of Persons with Incomes Exceeding £50,000 but not Exceeding £100,000.	Number of Persons with Incomes Exceeding £10,000 but not Exceeding £50,000.	Number of Persons with Incomes Exceeding £3,000 but not Exceeding £10,000.
1911-12	58	461	489	†	†	468
1912-13	59	483	561	†	†	486
1913-14	63	509	540	†	†	504
1914-15	63	547	647	570	535	541
1915-16	63	527	633	505	506	537
1916-17	80	592	741	541	593	593
1917-18	101	672	914	762	687	660
1918-19	130	738	871	821	760	724
1919-20	142	853	1,065	887	884	835
1920-21	153	988	1,259	1,122	1,047	953
1921-22	186	1,072	1,482	1,088	1,119	1,044
1922-23	115	972	1,000	921	966	977
1923-24	97	1,007	957	1,043	1,014	1,004
1924-25	96	1,021	1,036	1,034	1,021	1,020
1925-26	103	1,051	1,036	991	1,034	1,061
1926-27	101	1,053	1,079	932	1,022	1,072
1927-28	93	1,047	971	876	1,002	1,074
1928-29	90	1,075	971	876	1,015	1,111
1929-30 *	89	1,111	1,194	925	1,057	1,142
1930-31 *	85	1,111	1,014	905	1,048	1,149
1931-32 *	72	1,016	799	792	918	1,074
1932-33 *	61	854	683	552	752	915
1933-34 *	59	764	604	498	665	823
1934-35 *	59	734	468	484	643	789

* Surtax years corresponding are a year earlier.

† Figures not available.

ences have little value because they are so dominated by the price level change in 1921.) Similarly, for the group £5,000 to £10,000 compared with the price level, the signs are converse in *all* but six cases, and indeed negative correlation with the preceding columns is of course a necessity of the case.

All these results, comparing the class composition, are consistent with a change of the distribution slope (as well as of the aggregates) responsive to changes in the price level.

V. *The Behaviour of Class Averages.*

If under the pressure of price changes the slope of the income distribution is modified, this fact should come out in the average income within each class interval, for the number of holders towards

TABLE VIII.

Year.	Lauerbeck Index Number on Base of 1923-25.	Total— All Incomes over £5,000.	Incomes Exceeding £100,000.	Incomes Exceeding £50,000 but not Exceeding £100,000.	Incomes Exceeding £10,000 but not Exceeding £50,000.	Incomes Exceeding £5,000 but not Exceeding £10,000.
1911-12 ..	58	1,000	82	556 †		362
1912-13 ...	59	1,000	85	558 †		357
1913-14 ...	63	1,000	79	571 †		350
1914-15 ...	63	1,000	86	92	476	346
1915-16 ...	63	1,000	89	86	460	365
1916-17 ...	80	1,000	93	83	473	351
1917-18 ...	101	1,000	98	96	471	335
1918-19 ...	130	1,000	95	95	476	334
1919-20 ...	142	1,000	99	89	479	333
1920-21 ...	153	1,000	103	94	481	322
1921-22 ...	186	1,000	100	86	483	331
1922-23 ...	115	1,000	82	86	474	358
1923-24 ...	97	1,000	79	91	477	353
1924-25 ...	96	1,000	84	89	472	355
1925-26 ...	103	1,000	84	84	470	362
1926-27 ...	101	1,000	87	79	465	369
1927-28 ...	93	1,000	84	76	463	377
1928-29 ...	90	1,000	82	76	461	381
1929-30 *	89	1,000	88	76	460	376
1930-31 *	85	1,000	81	77	458	384
1931-32 *	72	1,000	74	75	448	403
1932-33 *	61	1,000	69	63	449	419
1933-34 *	59	1,000	65	63	444	428
1934-35 *	59	1,000	51	66	453	430

* Now described as surtax year for the years preceding.

† The official division of these figures is not available.

the bottom of the interval or bracket will tend to change in proportion to the number towards the top of the interval.

Table IX shows the relation between aggregates above three levels and the average incomes above those levels.

In the "over £100,000 class" a marked change in the aggregate has been accompanied by a change in the converse direction for the average of the class in all but 4 out of 17 cases, until we get to the last three years, when the converse relation breaks down, and those

cases where the change was in the same direction it will be seen were usually in respect of the second year of a change in one direction for the aggregate. But when we come to deal with the wealth in excess of the £10,000 line, the average income is much steadier throughout all the changes in volume, and the changes in the averages are in the *same direction* as the changes in the aggregate in nearly all cases. Naturally the class over £50,000 intermediate between

TABLE IX.

Year.	Total Income over £100,000.	Average Income.	Total Income over £50,000.	Average Income.	Total Income over £10,000.	Average Income.
	£000.		£000.		£000.	
1911-12 ...	12,506	183,900	23,387*	107,280	96,902	22,770
1912-13 ...	13,657	175,100	25,421*	105,920	103,260	22,850
1913-14 ...	13,501	180,000	26,027*	105,370	111,134	22,700
1914-15 ...	15,848	176,100	32,881	96,140	121,006	22,900
1915-16 ...	15,500	176,100	30,469	97,970	110,953	23,060
1916-17 ...	18,592	180,500	35,212	102,960	129,825	23,130
1917-18 ...	22,812	179,600	45,343	97,720	155,617	23,670
1918-19 ...	24,491	202,400	49,022	101,290	171,771	23,710
1919-20 ...	29,497	199,300	56,163	104,000	199,671	23,750
1920-21 ...	36,158	206,600	69,385	103,400	238,948	23,930
1921-22 ...	37,477	181,900	69,667	101,410	250,657	23,560
1922-23 ...	26,478	190,500	54,410	99,650	207,686	22,730
1923-24 ...	26,599	200,000	57,496	96,790	218,719	22,750
1924-25 ...	28,918	200,800	59,525	99,040	221,454	22,870
1925-26 ...	29,081	202,000	58,214	100,030	221,931	22,690
1926-27 ...	29,918	199,500	57,243	101,860	217,901	22,560
1927-28 ...	28,468	210,900	54,044	103,530	210,806	22,350
1928-29 ...	28,306	209,700	54,577	104,550	214,306	22,440
1929-30 ...	31,755	191,300	59,048	102,690	224,696	22,510
1930-31 ...	28,865	204,700	56,083	103,670	218,725	22,170
1931-32 ...	23,335	210,200	46,816	101,550	187,810	21,770
1932-33 ...	17,782	187,200	33,852	99,860	148,897	21,170
1933-34 ...	14,703	175,000	28,940	95,200	129,407	20,810
1934-35 ...	11,052	170,000	25,351	90,860	123,103	20,520

* These figures represent the total income over £55,000: the total incomes over £50,000 are not divided officially.

these, is more indefinite, for out of 23 changes in the aggregates, 13 were in the opposite direction for the average, and 10 were in the same direction for both average and aggregate, half of these being in the second year of that change of aggregate direction.

VI. Distribution of Real Incomes.

Although we have so far a clear case for stating that aggregates move broadly with the price level, and a *prima facie* case for con-

sidering that the slope of distribution changes too, the existence of *fixed* money income limits against which to test these changes makes comparisons very confusing, and one seeks to get rid of their influence. My first idea was to get rid of their fixity by turning them into real income variables, *e.g.*, to alter the £10,000-£50,000 money limits into purchasing-power limits by dividing them by the price index. Instead of knowing that we had x incomes of y £ total lying between £10,000 and £50,000 money limits, if the relative price level were 120 (for a base of 100), we should know that we had x incomes of y £ total lying between £8,333 and £41,667 purchasing-power limits. This would turn the statistical tables for each year into numbers and amounts of income between *different* sets of purchasing power limits, and I proposed to reconstruct these tables by Pareto interpolations into *constant* levels of purchasing-power limits. From this might be determinable how distribution in purchasing ability at each range changes with each variation in the price level. But adjustment of the fixed-income limits by the index number of prices gives such violent changes in those limits as to yield quite ridiculous results and variations in numbers and amounts of income, and the adjustment of such limits would have to be made by some unknown but more gentle variant of the wholesale price index. So I decided to get rid of class interval difficulties by an entirely different method, and not to beg the question of the real value of incomes. I ask the question: what is the amount of the money income of the "10,000th person" down from the highest income each year, and the "25,000th person" also? How do the fortunes of these representative and constant individuals vary with the varying price level? And it is upon this main basis that I pivot my statistical enquiry. If we had a known total of all incomes, we might take the upper decile or some other recognized constant position. But our total of incomes moves with the factor we are investigating—that is, the price level—as that level moves past a fixed money post, so that it is useless for our purpose. But the man I have chosen, being a fixed distance or number from one known end of the scale, is almost certainly quite close to a percentile as ordinarily understood, if the total number of *all incomes* does not vary greatly from year to year. He is the representative man whose income varies through changes due to the price level, and to any other proportionately working factor which forces statutory incomes generally downward. How is his income to be determined? Although we are now abandoning the use of fixed income brackets, I employ the statistics of them as a means to the end. In the surtax year 1929-30, for example, the tables gave us 9,867 incomes over £10,000, and another 4,359 in the £8,000 to

£10,000 class, so that we have to find the income of the man 133 down from the top in this class. Getting α for this narrow bracket (1.641) I interpolate with its value and make the required income £9,919. By determining α for the most limited range and using it to divide a small income total, the margin for error by this method is exceedingly small, and the constancy of the method still further limits the risk in annual comparisons.

Table X gives the range of incomes for the ten thousandth and twenty-five thousandth man respectively, and an index number

TABLE X.

Super-tax year.	(1) Income of the 10,000th. Person.	(2) Col. (1) Standard- ized on Average of Years 1922-23, 1923-24, and 1924-25 (9,658 = 100).	(3) Income of the 25,000th. Person.	(4) Col. (1) Standard- ized on Average of years 1922-23, 1923-24, and 1924-25 (8,255 = 100).	(5) Index of Wholesale Prices.	(6) Cost-of- Living Index.
	£		£			
1911-12 ...	5,748	60	—	—	58	61
1912-13 ...	5,933	61	—	—	59	61
1913-14 ...	6,170	64	—	—	63	63
1914-15 ...	6,486	67	3,431	65	63	64
1915-16 ...	6,252	65	3,364	64	63	63
1916-17 ...	6,811	71	3,593	68	80	70
1917-18 ...	7,501	78	4,001 *	76	101	83
1918-19 ...	8,009	83	4,264 *	81	130	101
1919-20 ...	8,869	92	4,709 *	90	142	116
1920-21 ...	9,991	103	5,226	99	153	123
1921-22 ...	10,410	108	5,534	105	186	142
1922-23 ...	9,436	98	5,151	98	115	129
1923-24 ...	9,745	101	5,284	101	97	105
1924-25 ...	9,793	101	5,330	101	96	99
1925-26 ...	9,863	102	5,434	103	103	100
1926-27 ...	9,790	101	5,434	103	101	101
1927-28 ...	9,651	100	5,404	103	93	98
1928-29 ...	9,729	101	5,498	105	90	96
1929-30 ...	9,986	103	5,615	107	89	95
1930-31 ...	9,919	103	5,601	107	85	94
1931-32 ...	9,181	95	5,282	101	72	90
1932-33 ...	8,166	85	4,745	90	61	84
1933-34 ...	7,612	79	4,441	85	59	82
1934-35 ...	7,459	77	4,329	82	59	80

* These figures have been adjusted.

for the two series (round about the base 1923-25). It also gives the wholesale price index number and cost-of-living index number on the same base, with the appropriate lag to make the statistical record of incomes synchronize. The comparisons of the series of index numbers is given in the graphs.

Let us consider first the 10,000th income series. Here there is an average deviation of 14.33 and standard deviation of 15.73 against a Sauerbeck price average deviation of 25.0, and standard deviation of 32.83. (I conjectured in Section I, from *a priori* reasoning, that the income deviation might be one-half the price deviation.) The average deviation of the cost-of-living index is 17.25 and the standard deviation 21.58. If a straight correlation coefficient with the cost-of-living index is taken, it works out at 0.849 ± 0.038 , with the Sauerbeck index 0.63 ± 0.082 , and with a combination of the two indexes 0.739 ± 0.062 . But I place no great stress upon these high figures, in view of the fact that one single year accounts for about a quarter of the xy numerator in the computation.* I prefer to correlate the sign only, and the "Coefficient of Concurrent Deviations" (by the formula $r = \pm \sqrt{\frac{2c - n}{n}}$) is 0.752 ± 0.061 with both the cost-of-living index and the wholesale price index.

Considering now the 25,000th income, the average deviation of the index is 12.19, against 24.24 for the wholesale price index, and 14.71 for the cost of living. (These two latter differ from those mentioned above because the series is shorter—we cannot compute the 25,000th income in the earliest years, as it falls below the taxation limit of £5,000.) Again, therefore, the range of variation in the incomes is about half that of prices and a little less than that of the cost of living. The standard deviations are respectively 13.98, 32.55 and 19.63. The coefficient of concurrent deviations with prices is 0.632 ± 0.090 and 0.775 ± 0.060 with the cost of living. [The direct coefficient of correlation of the 25,000th income with prices is much lower than for the £10,000 income, viz., 0.681 ± 0.078 with the cost of living, and 0.374 ± 0.126 for wholesale prices.]

The character of these connections between price changes and income changes is now becoming much clearer, and for social phenomena of this kind, with all the blurring of time effects inherent in tax statistics, is very striking. It appeals to the eye also in the graphs. The two types of income have very much the same ratio of variation compared with prices and cost of living, but the actual susceptibility to concurrent change is not quite so high in the smaller income.

The conformity of these series of representative incomes to changes

* As a matter of fact this is more an instinctive hesitation lest too great a degree of actual causation be suggested, than a justified objection. Actually if the peak years are omitted, σ and σ_1 are also correspondingly affected, and extremes do not modify the result to any great extent. In a tested case $+0.901$ actually becomes $+0.913$ when three extreme years are omitted. The high correlation cannot be explained away—the text merely indicates a desire not to claim too much from it.

in the price level is reasonably established, and the extent of the influence of prices indicated. But it still remains to ascertain by this method whether there is any evidence of a change of *relative* distribution upon a change of price level. This may be approached by considering the changing relationship between the 25,000th and the 10,000th income each year, and relating this to price-level changes. In Table XI the smaller income is expressed as a percentage of the

TABLE XI.

Super-tax year.	(a) Income of 10,000th Person.	(b) Income of 25,000th Person.	(c) Percentage (b) of (a).	(d) Column (c) Standardized on Average of Years 1923, 1924 and 1925 (54.4 = 100).
1914-15	6,486	3,431	52.9	97.2
1915-16	6,252	3,364	53.8	98.9
1916-17	6,811	3,593	52.8	97.1
1917-18	7,501	4,001	53.3	98.0
1918-19	8,009	4,264	53.2	97.8
1919-20	8,869	4,709	53.1	97.6
1920-21	9,991	5,226	52.3	96.1
1921-22	10,410	5,534	53.2	97.8
1922-23	9,436	5,151	54.6	100.4
1923-24	9,745	5,284	54.2	99.6
1924-25	9,793	5,330	54.4	100.0
1925-26	9,863	5,434	55.1	101.3
1926-27	9,790	5,434	55.5	102.0
1927-28	9,651	5,404	56.0	102.9
1928-29	9,729	5,498	56.5	103.9
1929-30	9,986	5,615	56.2	103.3
1930-31	9,919	5,601	56.5	103.9
1931-32	9,181	5,282	57.5	105.7
1932-33	8,166	4,745	58.1	106.8
1933-34	7,612	4,441	58.3	107.2
1934-35	7,459	4,329	58.0	106.6

larger each year, and this varies from 52.3 at its lowest to 58.3 at its highest. For graphical comparison this relationship is reduced to an index series and compared with the price index series. It will be seen that in the majority of cases (two to one) the relation is converse, and the smaller income tends to change to a higher percentage of the larger when the price level falls. The coefficient of concurrent deviation is — 0.55, but some of the changes are rather fine in magnitude. It is perhaps safer to group the results in a few classes of magnitudes, regardless of annual sequences:—

Price Level Index.	Cases.	Average Price Index.	Average Relation- ship Index.
Up to 75	6	63	103.7
Over 75 to 100	7	90	101.5
„ 100 to 125	4	105	100.4
„ 125	4	153	97.4

This series is regular in form. As the price level rises (not in time, but in magnitude) the percentage which the 25,000th income is of the 10,000th income steadily falls; in other words, the very rich gain relatively in income with a high price level, or lose relatively with a low—their income is more sensitive to the effects of the change.

VI. *Further Observation on Statistical Method.*

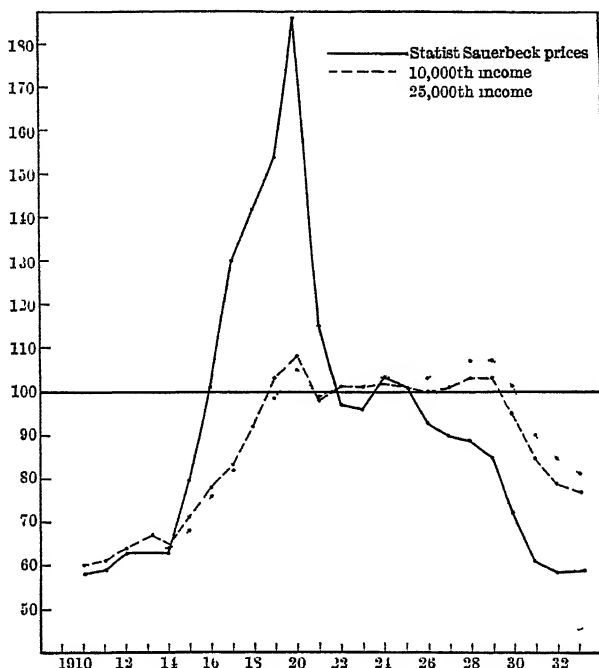
I have resisted in this paper two statistical temptations (or, at any rate, I do not publicly display my frailties). The first is to fit trends to these series. The price level may be considered to have three trends: first, that century-span rise which seems to be the way in which current business activity ultimately eludes the long-dead hand of past capital accumulation; second, the long-period swings dependent upon changes in gold production and credit technique; and third, the effect of the trade cycle undulating about the second. Over this period of twenty years it can only be the third in which we are interested for this purpose. But he would be a bold man who would say that he could fit the real economic trend for a period which includes the Great War, the excess profits duty, being off the gold standard, then on it, and then off it again. Of course, a straight-line trend can be put in (or two of them) by the method of least squares, but whatever mathematical significance that might have, it would certainly have no economic meaning. The income series may be alleged to have a "normal growth" trend, for the increase in population, but to mean anything at all this must be the adult "gainfully-occupied" population, and in the absence of knowledge of the growth of real income (not money income) for the whole of the population, allowing for unemployment, it is rather begging the question to assert that there is a definite constant growth trend in this small super-tax *section* of the population. It is true that the index of the number of incomes over £5,000 has risen from 547 with the price index at 63 in 1914-15, to 854 with the price index at 61 in 1932-33, but I hesitate, even with this evidence, to fit a straight-line trend as really significant.

My second abstention is partly the result of my first. I have not attempted to correlate first differences. For while ignoring the time growth trends in two contrasted series gives a spuriously high correlation, it is also unsatisfactory even if only one growth trend is ignored—and in any case I am alive to the objections to the difference method on general grounds.

VII. *Conclusion.*

In the course of this examination, with many alternative tests that I have not included in the paper, the limitations of both data

and method have become obvious, but nevertheless certain massive and clear answers to some of the questions posed in my opening section have emerged. Owing to the non-existence of graduated scales for the great mass of lower incomes, we are unable to attack their problem directly, but it is not unreasonable to suppose that in the middle ranges they share the relative inertness of the lower section we have examined, and that they rise and fall less than the upper ranges with the price level, and bear the burden of reduced purchasing



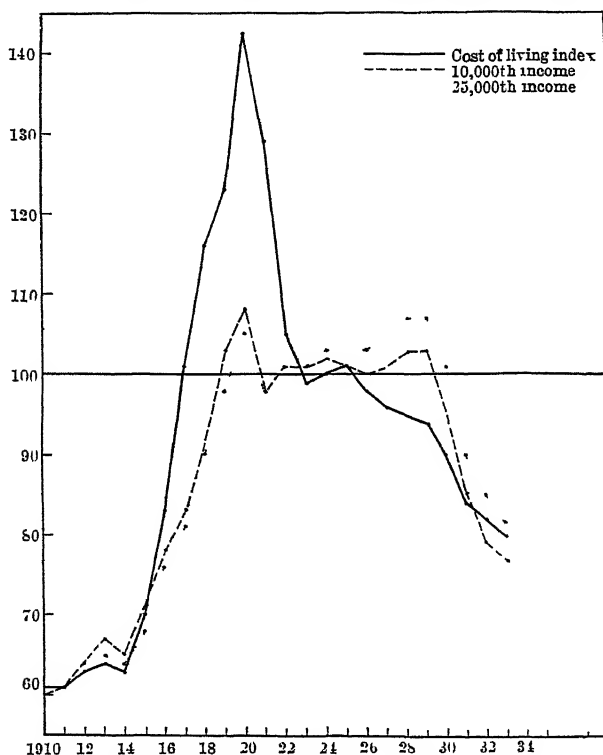
power, or enjoy the boon of increased power, more definitely. Different considerations apply in the lower field of wages, and non-composite incomes.

But perhaps the most interesting phenomenon we have had under review is the rapid decline of all the classes of late years, which is certainly greater than can be accounted for by the price variation alone. Four causes suggest themselves :

- (1) The incompleteness of the assessments for recent years.
(The small degree of correction necessary for this is indicated in Section III.)
- (2) The extent of the trade depression from 1930 to 1933.

- (3) The successful adoption of methods of legal avoidance and arrangement of income resources so as not to "attract" taxation, and
- (4) The degradation of the taxable corpus under the influence of the heavy duties themselves over a long period.

When the largest blocks of capital and attached income are being attacked simultaneously by capital and income duties in excess of 50 per cent., we may well expect that some deterioration of the corpus



will set in. (In this connection, I may refer to my analysis of the effect of the Capital Levy over a long period, in *Current Problems in Finance and Government*, which shows how much the income from the flock of geese, made up of the combined income from golden eggs and from disposing of some of the geese, varies according to the proportion of geese taken.)

If we assume that the top range of estates is not altered by aggregation to, or division amongst, individuals, and that it would tend to accumulate at 4 per cent. per annum, the income not being used for consumption purposes, an income tax and super-tax burden of 60 per cent. reduces the net rate of accumulation to 1.6 per cent.

per annum. But if we assume also that it comes under death duties once in 25 years, 4 per cent. per annum will pay 50 per cent. duty, and make a net deduction from the corpus of 2 per cent. per annum. The rate of subtraction exceeds the rate of addition by 0.4 per cent. per annum and the corpus of wealth must slowly diminish. When the rate of interest is low, this tendency may be important, but it is not enough to reduce the higher branches of income substantially yet, or at the present rate. Nor do the statistics of estate duty over the past ten years confirm the suspicion that the total of estates over £10,000 is getting "worn down," though it is certainly not very progressive, being practically the same now as eight years ago—while those over £1,000,000 in the past quinquennium of depression are slightly below those of the previous quinquennium of increasing prosperity. Of course, the same cause—low rates of interest—that decreases incomes maintains capital values or increases them, so that the trend of figures in the two classes is consistent. We cannot plead, however, that mechanical fiscal entropy is yet very pronounced by any test, and we must look to the second cause—legal avoidance—for the main reason for the disproportionate fall in the incomes assessed to surtax. From 1929–30 to 1933–34 the total fell from £593,000,000 to £400,000,000, or nearly one-third, and "Actual income" assessed to income tax went from 2,530,000,000 to 2,505,000,000, a negligible change. We ought, however, to allow some £300,000,000 of this for changes in the exemption limit, so that surtax income fell from 23½ per cent. to about 18 per cent. of the whole. This comparison is, however, rather artificial and misleading. A good part of the fall is accounted for by the people who had over £2,000 for 1929, but have slipped below, though the incomes still exist, for 1933. It is another example of the perils of fixed limits, which I at first overlooked. 30 millions £ should be allowed for this item. When the effect of the revival of trade and profits shows itself fully in the income-tax assessments, the extent of the corresponding upward movement will be a crucial indication of the true underlying causes of these changed proportions.

(In his Budget Speech on April 22nd, the Chancellor of the Exchequer anticipates an increase of £3,500,000 or 7 per cent. for the surtax year 1935–36, which represents an important revival in the falling curves of these graphs due to trade changes alone, and the rising price level. The prevention of legal avoidance is to yield £6,500,000, which still further puts up the aggregates—in this ratio the 18 per cent. proportion referred to above would be 20 per cent. In due course it may be possible to test from the statistics the assumption in this paper, that the changes from year to year of relative distribution are not greatly influenced by such practices, applying proportionately down the line.)

Super-tax Statistics.

Incomes		1911-12.		1912-13.		1913-14.		1914-15.		1915-16.	
Exceeding.	Not Exceeding:	Number of Persons.	Total Income.	Number of Persons.	Total Income.	Number of Persons.	Total Income.	Number of Persons.	Total Income.	Number of Persons.	Total Income.
£	£		£000.		£000.		£000.		£000.		£000.
3,000	5,000	—	—	—	57,208	8,769	59,861	15,524	59,776	15,306	58,549
5,000	10,000	8,143	55,049	8,445	26,734	2,362	28,556	9,404	63,986	9,348	63,860
10,000	15,000	2,090	25,190	2,210	14,940	980	16,870	2,561	30,782	2,317	28,537
15,000	20,000	813	13,987	866	10,611	502	11,205	1,034	17,825	931	16,060
20,000	25,000	442	9,771	479	12,127	454	13,284	537	11,933	489	10,920
25,000	35,000	393	11,558	413	7,880	222	8,830	495	14,531	445	12,953
35,000	45,000	191	7,581	202	5,547	128	6,362	229	9,089	221	8,816
45,000	50,000	109	5,428	110	3,458	64	3,806	85	3,965	67	3,198
50,000	55,000	57	3,350	59	2,554	43	3,003	61	3,241	50	2,016
55,000	65,000	36	2,523	37	5,752	65	5,717	75	4,498	68	4,062
65,000	75,000	57	5,008	66	13,657	73	13,501	47	3,306	43	2,963
75,000	100,000	68	12,506	78	160,468	13,664	170,995	69	5,988	62	5,328
100,000								90	15,848	88	15,700
Total		12,399	151,951	12,965	100,468	13,664	170,995	30,211	244,768	29,465	233,362

Super-tax Statistics.

Incomes.		1916-17.		1917-18.		1918-19.		1919-20.	
Exceeding:	Not Exceeding:	Number of Persons.	Total Income.	Number of Persons.	Total Income.	Number of Persons.	Total Income.	Number of Persons.	Total Income.
£	£		£000.		£000.		£000.		£000.
2,500	5,000	—	61,755	17,504	67,256	28,038	97,882	31,603	110,768
3,000	5,000	16,065	70,359	—	—	—	—	—	—
5,000	10,000	10,306	32,151	11,486	78,438	12,586	86,101	14,515	99,559
10,000	15,000	2,661	19,377	3,079	37,224	3,413	41,350	3,909	47,282
15,000	20,000	1,129	13,683	1,265	21,747	1,397	24,002	1,660	28,465
20,000	25,000	612	9,245	710	15,906	735	16,447	894	19,970
25,000	30,000	339	12,123	422	11,474	501	13,646	519	14,203
30,000	40,000	353	8,034	420	14,434	439	15,137	584	20,092
40,000	50,000	178	9,053	214	9,489	276	12,167	302	13,496
50,000	75,000	162	6,667	239	14,240	257	15,274	279	16,886
75,000	100,000	77	18,592	98	8,285	106	9,257	113	9,780
100,000		103		127	22,812	121	24,491	148	29,497
Total		31,985	261,939	35,564	301,311	47,869	355,754	54,526	409,998

Super-tax Statistics.

Incomes.		1920-21.		1921-22.		1922-23.		1923-24.		1924-25.	
Exceeding :	Not Exceeding.	Number of Persons.	Total Income.	Number of Persons.	Total Income.	Number of Persons.	Total Income.	Number of Persons.	Total Income.	Number of Persons.	Total Income.
£	£		£000.		£000.		£000.		£000.		£000.
2,000	2,500	14,476	33,224	20,547	46,251	22,014	49,339	22,763	51,243	23,413	52,971
2,500	3,000	12,821	35,095	14,596	39,972	14,932	40,844	15,393	42,259	15,604	43,259
3,000	4,000	15,082	54,191	17,543	60,565	17,400	59,919	17,950	61,982	18,503	63,643
4,000	5,000	9,176	40,954	9,962	44,559	9,665	43,117	9,960	44,070	10,318	46,149
5,000	6,000	5,869	32,087	6,483	35,458	6,136	33,493	6,266	34,287	6,398	34,847
6,000	7,000	3,985	25,805	4,449	28,800	4,188	27,139	4,282	27,650	4,316	27,903
7,000	8,000	2,858	21,410	3,118	23,330	2,860	21,410	2,978	22,259	3,067	22,929
8,000	10,000	3,859	34,390	4,112	36,714	3,793	33,783	3,928	35,028	3,964	35,474
10,000	15,000	4,704	56,771	4,973	60,258	4,421	53,457	4,610	55,767	4,621	55,865
15,000	20,000	1,968	34,069	2,097	36,232	1,835	31,479	1,903	32,718	1,977	34,046
20,000	25,000	983	22,021	1,108	24,712	924	20,603	1,017	22,610	1,027	22,772
25,000	30,000	628	17,199	709	19,381	523	14,295	577	15,737	555	15,113
30,000	40,000	656	22,531	704	24,263	579	19,638	600	20,492	595	20,461
40,000	50,000	376	16,972	363	16,144	309	13,804	312	13,899	307	13,672
50,000	75,000	356	21,176	358	21,684	288	17,659	340	20,432	328	19,530
75,000	100,000	140	12,051	123	10,506	119	10,273	121	10,465	129	11,077
100,000		175	36,158	206	37,477	139	26,478	133	26,599	144	28,918
Total		78,712	516,104	91,451	566,306	90,125	516,730	93,133	538,097	95,296	548,629

Super-tax Statistics.

Incomes.		1925-26.		1926-27.		1927-28.		1928-29.		1929-30.	
Exceeding :	Not Exceeding :	Number of Persons.	Total Income.	Number of Persons.	Total Income.	Number of Persons.	Total Income.	Number of Persons.	Total Income.	Number of Persons.	Total Income.
£	£		£000.		£000.		£000.		£000.		£000.
2,000	2,500	23,807	53,873	24,578	55,141	24,836	55,850	25,363	57,056	26,916	60,339
2,500	3,000	16,190	44,686	16,535	45,329	16,914	46,302	17,270	47,295	18,066	49,355
3,000	4,000	19,143	66,005	19,520	67,371	19,599	67,571	20,216	69,756	21,012	72,374
4,000	5,000	10,661	47,641	10,792	48,311	11,032	49,276	11,278	50,414	11,560	51,552
5,000	6,000	6,612	36,153	6,756	37,025	6,793	37,195	6,998	38,277	7,263	39,738
6,000	7,000	4,476	28,926	4,532	29,111	4,480	28,998	4,629	29,913	4,839	31,339
7,000	8,000	3,148	23,573	3,082	23,121	3,242	24,225	3,368	25,120	3,452	25,814
8,000	10,000	4,211	37,523	4,275	38,104	4,171	37,118	4,329	38,482	4,311	38,307
10,000	15,000	4,803	58,118	4,778	57,740	4,696	56,505	4,749	57,537	4,918	59,831
15,000	20,000	1,913	33,003	1,911	32,913	1,851	31,703	1,875	32,194	1,960	33,747
20,000	25,000	999	22,288	954	21,286	979	21,822	972	21,591	1,017	22,560
25,000	30,000	562	15,303	579	15,836	565	15,475	555	15,218	605	16,598
30,000	40,000	614	21,205	586	20,065	538	18,573	603	20,840	593	20,320
40,000	50,000	309	13,800	289	12,818	283	12,084	276	12,349	283	12,622
50,000	75,000	322	19,234	306	18,441	291	17,371	275	16,546	304	18,252
75,000	100,000	116	9,899	106	8,884	96	8,205	112	9,725	105	9,041
100,000		144	29,081	150	29,918	135	28,468	135	28,306	166	31,755
Total		98,030	560,311	99,729	561,714	100,501	557,341	103,033	570,619	107,400	593,514

Super-tax Statistics.

Income.		1930 '31.		1931-32.		1932-33.		1933 '34.		1934 '35.	
Exceeding:	Not Exceeding:	Number of Persons.	Total Income.	Number of Persons.	Total Income.	Number of Persons.	Total Income.	Number of Persons.	Total Income.	Number of Persons.	Total Income.
£	£		£000.		£000.		£000.		£000.		£000.
2,000	2,500	27,518	61,774	27,046	60,539	25,274	56,459	23,855	53,382	22,515	50,361
2,500	3,000	18,295	50,025	17,839	48,763	16,412	41,905	15,237	41,657	11,330	39,183
3,000	4,000	21,434	73,903	20,493	70,557	18,589	63,966	17,219	59,277	16,250	55,918
4,000	5,000	11,788	52,577	11,277	50,275	10,103	44,991	9,202	41,028	8,754	38,377
5,000	6,000	7,426	40,541	6,943	37,898	6,098	33,296	5,388	29,411	5,190	28,350
6,000	7,000	4,806	31,098	4,538	29,176	3,846	24,873	3,603	23,280	3,379	21,849
7,000	8,000	3,398	25,373	3,130	23,390	2,650	19,818	2,352	17,595	2,265	16,932
8,000	10,000	4,359	39,015	4,063	36,149	3,327	20,599	2,970	26,443	2,881	25,687
10,000	15,000	5,018	60,762	4,409	53,316	3,711	44,890	3,377	40,702	3,189	38,487
15,000	20,000	1,913	32,790	1,733	29,617	1,337	22,871	1,174	20,340	1,201	20,758
20,000	25,000	1,001	22,323	816	18,782	693	15,367	538	11,770	518	12,216
25,000	30,000	551	15,064	481	13,208	380	10,363	331	9,040	293	7,919
30,000	40,000	565	19,331	483	16,551	384	13,162	337	11,648	339	11,705
40,000	50,000	278	12,372	215	9,520	188	8,372	157	6,967	149	6,667
50,000	60,000	279	16,806	259	15,564	186	11,086	175	10,436	165	10,131
60,000	75,000	121	10,412	91	7,917	58	4,984	45	3,801	49	4,168
75,000	100,000	141	28,665	111	23,335	95	17,782	84	14,763	65	11,052
100,000											
Total		108,891	593,061	103,957	544,557	93,361	466,801	86,044	421,510	81,562	400,390

DISCUSSION ON SIR JOSIAH STAMP'S PAPER.

PROFESSOR A. L. BOWLEY: It is my pleasant duty to propose the vote of thanks to Sir Josiah Stamp for the paper he has read. The subject which he has chosen is not exactly novel, because we must have reflected upon it before, but it is novel in treatment. No one has, I think, attempted to give an answer to the questions he has raised, or at any rate has published the results of his cogitations.

It is perhaps ungrateful to ask for more when so many computations have been made, but there are one or two things I should have wished to see in preference to the laboured negative computations which are perhaps not very helpful to following out the line of thought. I should like to have seen in one of the last graphs a graph of money wages against the cost of living, for it is evident that a movement of the purchasing power of wages is much nearer that represented by the cost-of-living index than are any of these higher incomes, and I think it would have made a good base to his pyramid to have brought in these figures, and to have seen in the end whether the movement of real wages over the last few years interpreted in this way is near the movement of the 25,000th man's income also interpreted by prices.

But why take the 10,000th man and not the 1,000th man? The figures are very detailed at the top of the scale; it is the man high up in income who is more likely to be affected in a peculiar way by the changes in prices or the changes in all the various constituents which make the purchasing power of money. Is it asking too much to have that other line put in; these two lines of the 10,000th and 25,000th man are so nearly parallel optically that they seem to suggest a similarity which I dare say did not really exist.

I am sorry the idea of using percentiles was given up. Mr. Connor used the method very skilfully, but he was not dealing with the same problem, and there is the difficulty that we did not know the number of incomes to divide. But why not guess? We know the amount of population; we could guess what is the difference? Perhaps this is one of the games the reader of the paper played, but did not dare to bring forward. If not, I suggest it to him as another little game he might indulge in.

The method I should have taken next after the one he took is suggested by Table IX on p. 647. Sir Josiah Stamp may remember that about the date to which the beginning of this paper refers we were in the reversed position. I was lecturing in the temporary buildings now occupied by the Cobden Library, and I pointed out the relation between average income and Pareto's Law, and Sir Josiah Stamp took part in the discussion, and said "These are higher mathematics." I do not think he would have regarded them so now; in this matter I think he has progressed, as well as in climbing up the scale of super-taxincome. Average Income over £x by Pareto's

Law is $\pounds \frac{\alpha}{\alpha-1} \cdot x = \pounds \delta \cdot x$, where δ is Professor Gini's measurement.

Thus if $\alpha = 1.5$ as Pareto suggested $\delta = 3$.

Instead of £3.*x* for the average, we find from Table IX, with a column for income over £5,000 inserted

				Values of δ			
$x = 5,000$				10,000	50,000	100,000	
1911	...	...	2.34	2.28	2.14	1.84	
1920	...	...	2.67	2.39	2.07	2.07	
1930	...	...	2.38	2.22	2.08	2.05	
1934	...	...	2.29	2.05	1.92	1.70	

I think the change in these figures over the period is very important. The mere fact that there is a regular change over long periods of years is important in itself. It suggests that when you come to compute along the scale, supposing the Pareto line to go straight through, the number falls off from the maximum and instead of being 3, it was in 1911 2.34 at £5,000, 1.84 at £100,000.

My point is that with that growth, and the numbers carefully studied, one could find the actual change in wealth, and what has been the actual change in incomes; also it would be possible to find out in what way the higher incomes fall. That process of study would be interesting, and we have all the material here in Table IX.

The other point I hope will be discussed is what is the appropriate index number of prices to apply to higher incomes. It is quite clear that neither of the numbers here is appropriate, and I should not expect a wholesale price index number to be appropriate, because people do not generally buy wholesale.

I am not at all certain from the diagrams on pp. 653-4 whether in fact the real income of the 10,000th man has fallen for the last eight years, or not. That particular topic of the adjustment of prices is, I think, the one which calls for most discussion this evening, for the statistics themselves are so accurate and elaborate that I doubt whether we should spend our time very well in elaborating or criticizing them.

PROFESSOR J. H. JONES: I rise with great pleasure, but as a very inadequate substitute for a more statistically minded Fellow of the Society, to second the vote of thanks to Sir Josiah Stamp.

Sir Josiah has taken out his theodolite and surveyed a field very close to other fields which he has surveyed in the past, and he has produced a paper full of human as well as scientific interest. I do not refer to the pressure of the cost of living upon the people whose incomes have been reduced from £51,000 to £41,000 per annum, nor to the injury to their pride through having been placed in a lower statistical category; but Sir Josiah defines higher incomes as incomes from two thousand pounds per annum upwards, and he has such a profound contempt for incomes between two and five thousand pounds that he devotes most of his paper to the people who have received more than the latter amount.

I felt as I read the paper that my first duty was to send a copy to the Chairman of the Finance Committee of the institution to which I belong. It is now too late, because he sails to-morrow in the

"Berengaria," but I hope he will learn the same lesson on the other side of the Atlantic.

There is another point of extreme human interest in the paper, and that is the reference to the fact that an assessment for any one year is repeated, with amendments, for five successive years, and, with very few exceptions, the assessment increases from year to year. That, I think, is revealing.

I feel a little unhappy about the title of the paper. I say nothing at all about the statistical technique or the way it is used, because I am not competent to do so, but the paper is called, "The Influence of the Price Level on the Higher Incomes," which suggests that the price level, as such, produces an effect upon incomes. The title might have been given in other words, for example, as "The Statistical Connection between the Price Level and the Level of Higher Incomes," in which case the writer of the paper would have confined himself to those statistical details that some people seem to enjoy. Or he might have styled the paper, "A Study of the Factors which Influence the Price Level on the One Side and the Level of Incomes on the Other." I feel that in choosing the words that he has chosen, Sir Josiah has fallen between two stools, owing, of course, to the fact that in this paper he is never quite sure whether he is a statistician or an economist.

The paper resolves itself in the last resort into a discussion of the effects of a process of change. The absolute price level does not matter in the least. If we call a pound "ten pounds" in every individual case, then nothing is changed except that the class interval is multiplied in the way indicated on p. 627. That is not, I think, what this paper is ultimately concerned with, because the writer refers in more than one place to the fact that the period is so short that he is concerned more with the trade cycle than with long period trends extending to more than, say, twenty years. What we are ultimately concerned with is the effects of cyclical changes in industry upon the price level on the one side and upon various categories of income on the other. That is the problem in which an economist is primarily interested, and as one who does not claim to be a statistician, I claim Sir Josiah Stamp as an economist.

The paper appears to be summed up in the statement that higher incomes fluctuate broadly with prices, and that within the category of higher incomes, the 10,000th man has an income that fluctuates more than that of the 25,000th man; that is to say that the fluctuation seems to vary directly with the amount of the income.

In another part of the paper Sir Josiah points out that in respect of the last three years or so that broad statement has to be modified on account of the intensity of the depression of the last three or four years. I mention that partly to show that Sir Josiah is really concerned with the intermediate effects of a process of change rather than with a final comparison of two states widely separated, and my difficulty in handling statistical material dealing with prices is that in a world of constant change I cannot distinguish between them.

Another point that emerges from what Sir Josiah himself has

said, is that in spite of all changes that have taken place, higher incomes seem to persist. I am surprised, myself, to see the way in which they have so far survived the ravages of the Chancellor of the Exchequer, particularly in the form of death duties. I had expected to find that death duties would have produced a far bigger effect upon the accumulation of capital and investment income than in the past, and I therefore suggest that he should give up talking about geese and golden eggs, and say "rabbits" instead.

With Professor Bowley, I wish Sir Josiah had added to his curves a curve of wages. I agree that it is difficult at first sight to justify the use either of the wholesale price index number or the cost-of-living index number. To an economist I think the justification would be that they would show what I have already tried to say, namely, that the price level changes indicate the profitability of industry, and the profitability of industry indicates the amount of large incomes. But if in addition to these two price levels there had been introduced a chart showing the changes in money wages since 1920 or 1922, we should have been able to compare the statistical connection between wage changes on the one side and large income changes on the other. During the years 1920-24, there was a marked downward movement in wages, but after 1922 large incomes appeared to recover. One wonders whether there was any connection between those movements. If we take the period 1931-34, the higher incomes move down a very steep slope, but the wage chart would show, I think, that wages did not follow to any great extent. Is there an inverse relation between the wage curve and the higher incomes curve? I rather think there is, and I should have liked to see Sir Josiah work that out more fully than he has done in the paper.

My final point is this. There is a connection between the work that has already been done by Sir Josiah Stamp in the region of profits and the work that he has done in the preparation of this paper. Large incomes are mainly investment incomes. The lower you go down the scale, the larger the proportion of individual income that is due to personal day by day effort, and the extreme fluctuations in the larger incomes really represent variations in the rate of profit. Moreover, it is generally believed that the higher the income, the larger the proportion due to speculative investment, as distinguished from secure investment. Whether that is true, I do not know, but it seems to me to be a critical point in connection with the paper, and I hope Sir Josiah will pursue his investigation further and enlarge on these last two points in order to give a fuller picture than he has here.

I have pleasure in seconding the motion of a vote of thanks to Sir Josiah Stamp.

MR. HENRY CLAY said that Professor Jones had expressed, better than he could have done himself, the chief points he wished to make in connection with the paper. On p. 653 Sir Josiah Stamp said: "Perhaps the most interesting phenomenon we have had under review is the rapid decline of all the classes of late years, which is certainly greater than can be accounted for by the price variation

alone." It might be pointed out that the fall in incomes preceded by two or three years the fall in prices, and it might be better if the phrase were varied in some such way as to say "is certainly greater than can be accounted for by those changes of which price variations are an index." The phrase needs qualification, as the diagrams show clearly that the great fall has been since 1928 or 1929, or perhaps a year or two earlier, if the tax assessment years are to be substituted by the years in which incomes are earned. Apart from this recent fall there seems to have been an upward trend of the incomes of the two representative gentlemen whom Sir Josiah selected.

It occurred to him that it would be interesting to compare the movement of super-tax income and actual income, given on pp. 659-660, with certain other indices. Between 1928-29 and 1932-33 super-tax income fell by 32 per cent.; wholesale prices fell in about the same degree.

Income-tax income fell by 13 per cent.; cost of living fell by $12\frac{1}{2}$ per cent.; employment fell by $10\frac{1}{2}$ per cent.; wage rates fell by 5 per cent. This comparison not only brought out the closer connection between the variations in these higher incomes and cyclical changes in trade, but also supported the contention put forward by Sir Josiah, which Mr. Clay would like to stress, that the changes in these higher incomes was less than one expected *a priori*. Particularly impressive was the stability of a large mass of income-tax income, the more so when one took account of the fact that a part of the fall was accounted for by a fall below the level of two thousand pounds, if incomes had still remained in existence at a slightly lower level.

Professor Bowley had asked what index price number would be most useful. It seemed to Mr. Clay that no index number of commodity prices would serve a useful purpose. In incomes as high as the first 10 or 25 thousand incomes, the changes in commodity prices would not have a great effect upon the standard of actual living. A large part of these incomes must be invested. The largest element in consumption was the compulsory consumption of Government services. Any study of distribution must take into account also the part of the incomes of different classes which was taken in the form of taxation. If real incomes were to be compared, net real incomes must be taken, though this involved distinguishing between transferred taxation and taxation which was not transferred.

Anything that Sir Josiah Stamp chose to publish, either on the subject of the national income or on the effect of price changes, was important and valuable; but Mr. Clay confessed to a slight feeling of disappointment when he received this paper, because when he had first heard it mentioned by Sir Josiah Stamp himself, he had not included such an adjective as "higher" before "incomes," and he was therefore looking for a paper on the general influence of price level upon incomes. The number of incomes that came into the super-tax class could not be more than $\frac{1}{2}$ of one per cent. of all incomes, and the number of incomes that came within the class of £5,000 a year was less than 1 per mille of all incomes. He appealed to Sir Josiah Stamp to supplement the paper on some

future occasion by a more general survey of the distribution of incomes in different phases of the trade cycle.

With regard to the general trend, it did not seem, when one took account of the extent of the recent depression, that it was necessary to attach the importance that had been done to the element of tax evasion: nor, when we took account of this presumably temporary influence, was there any marked trend in the downward direction. It was surprising that high taxation had had no greater effect than was shown by these statistics.

A short time ago Mr. Campion had made a study of the distribution of capital, the effect of which was to show that the distribution of capital was slightly less unequal in 1930 than before the war. The effect of taxation on the distribution of capital was offset by the increasing opportunity of earning current income, and it was becoming doubtful whether one could assert, as Professor Jones did, that the higher incomes were mainly invested incomes. The element of earned income did explain an increasing proportion of the higher incomes, and this more than offset the effects of taxation in counter-acting saving and reducing the effects of inheritance.

SIR WILLIAM BEVERIDGE said he would ask for elucidation of a phrase to which reference had already been made. The survey "had under review the rapid decline of all the classes of late years, which is certainly greater than can be accounted for by the price variation alone." Looking at the chart on p. 653, which showed the movement of the *Statist* prices of the 25,000th income, it struck him that of late years the gap and movement of those incomes and the movement of prices had been more nearly parallel. He would like Sir Josiah Stamp to explain what he meant by saying that the fall of the income of the 10,000th man and the 25,000th man was greater than could be explained by price variation. The actual proportional fall was the same as shown by the chart. Having looked at the chart, he then did some hasty statistics with reference to another table, and could give the results, subject to being allowed to check his figures subsequently.

If the years 1929-30 were compared with 1934-35, it would be seen that the Sauerbeck Index had gone from 89 to 59, which was a fall to 66 per cent., *i.e.*, by 34 per cent.

On turning to those tables in which were given the numbers and the incomes in the various classes, if one worked out the people between the £2,000 and the £5,000 income, it would be found that their number had fallen between 1929-30 and 1934-35 to 80 per cent., and their income to 79 per cent., as compared with 66 per cent. of the Sauerbeck Index; that was to say, the incomes had fallen much less than the prices.

If one took the next class, £5,000 to £10,000, both the number and the total income had fallen from 100 to 69 per cent., as compared with 66 per cent. of the price index. In the £10,000 to £50,000 class the fall is to 59 per cent. of the total income and to 51 per cent. of the number of incomes. Between £50,000 and £100,000 the fall of income is to 52 per cent. from 100, and above £100,000 the fall

of total income is to 35 per cent., so that clearly there is a much greater proportional fall as one goes up the scale of incomes. That is to say, in income classes above £10,000 the incomes have fallen more than in proportion to the Sauerbeck Index, while in income classes below £10,000 the fall of income has been less than in proportion to prices. This is an obvious reflection of the fact that people have been transferred from one class to another.

Having got these figures, he realized that he was getting to a truism, but this did not dispose of the apparent parallelism of the incomes between the 10,000th man and the Sauerbeck Index, and he would like Sir Josiah Stamp to explain just what he meant by saying that all classes had fallen more than in proportion to the price index.

Sir William said that he was only asking this question and not criticizing the paper, for which he was profoundly grateful, although they would all be more grateful when he came to deal with incomes with which they were more familiar.

DR. MARSCHAK thought the method used by Sir Josiah Stamp gave excellent results as a way of testing two theories. First, the theory Mr. Keynes advanced in 1930 in his treatise reviewed by Sir Josiah Stamp in 1931. According to Keynes, profits were due mainly to the difference between the levels of prices in two successive periods.

It would have been possible for Sir Josiah Stamp to state the change of price-level during each year and compare it with the profits of the higher incomes. But even if the diagram on p. 653 were looked at as it stood, Mr. Marschak thought it might show to what extent Keynes's theory might or might not be proved by Sir Josiah's facts. If the increase of prices during a year were always positively correlated with the level of prices in that year, then the price curve shown in the diagram on p. 653 would look thus: the higher the prices the quicker the increase in prices and slower the decrease. If the price curve had more or less this form, Sir Josiah's correlation between high incomes and high prices would point to a correlation between high incomes and increasing prices, and Keynes's theory would be supported. Mr. Marschak did not think it was, because neither the Sauerbeck Index nor the cost of living index showed (pp. 653-4) this kind of movement. It could not, therefore, be accepted from these results that profits were mainly due to inflationary processes.

The second theory was the assumption underlying that formula of Gibrat which Sir Josiah Stamp had tried to use for smoothing his income data. Gibrat assumed that any random cause changing an income must have an effect proportionate to that income itself. If this assumption held good, the lines for the 10,000th and 25,000th incomes on Sir Josiah's chart would coincide, because incomes would increase or decrease in the same proportion. The chart showed that this was not the case, but it might suggest some alternative formula based on a generalized assumption such as "the effect of a random cause on income is proportionate to a certain function of

that income." Sir Josiah Stamp's time series for different incomes might thus show a way of finding an improved Gibrat formula which could be used later for the purpose of statistical smoothing of income-distributions.

MR. COLIN CLARK said that it was a source of wonder to all how Sir Josiah Stamp could find time to compile such an intricate paper.

He had been particularly interested in the statistical problem thrown out by Professor Bowley about the right price index number, and the idea of a price index number for the rich. In 1930 he, the speaker, had disputed this matter with a wealthy young man who complained of the decline of his income from his investments, and had tried to persuade him that he was getting benefit from the reduced cost of living—which he finally admitted. Some interesting budgets for this type of person had been collected in America—budgets for 30 or 40 families living on incomes of from \$12,000–16,000 a year. The average figures were something like this:—

Expenditure on food	...	...	10 per cent.
Maintenance of the home, including domestic service	...	...	16–20 ,,
Other consumption of services	...	12–23	,,

It was at any rate clear that of the income spent, at least half was spent on services, and not on commodities. This indicates that the only appropriate price index was one of money wage-rates.

If price problems were looked at from another angle, an index number would have to be used in which the known prices of goods and services were weighted according to their importance in outgoing rather than consumption, and this would show surprisingly little movement, even for the years 1929–33.

There was one small point about the timing. Sir Josiah's figures showed maxima in 1929–30 and 1930–31, and it was to be presumed that these referred to incomes earned in the previous years—in other words, that incomes earned in 1928–9 were maxima. The price figures appeared to have been lagged on that assumption.

When it came to measuring how far the very rich had been the greatest sufferers from the slump, Sir Josiah gave figures to show a decline of 28 per cent. in the 10,000th and 25,000th incomes, which was much greater than the decline of the average income of all in work in the same period. Looking at the more long-period trend, Sir Josiah gave a quite clear correlation showing that during periods of rising prices there tended to be a certain level of the factors measuring the difference in the incomes of the 10,000th and the 25,000th person. It was impossible to prove that that was not simply due to time alone and was not independent of the movement of prices. It might be necessary to wait another twenty years before a decision could be made on that point.

Professor Bowley had said that if you did not know the total number of incomes, you could guess it. But this figure could be approximately determined from the Census. Knowing this figure,

some most interesting comparisons could be made between the relative frequencies of different incomes, as calculated by Professor Bowley for 1911, and as found at the present day. Making allowance for the change in price-levels, an income of £5,000 in 1911 might be said to correspond to one of £7,000 at the present time, and an income of £160 in 1911 to one of £250 at the present time. The proportion of all incomes above the higher of these limits was 0.061 per cent. in 1911 and 0.090 per cent. now, but in each year the proportion of the national income taken by persons with incomes above this limit was the same.

In the case of incomes above £250 (£160 in 1911) it was found that the proportion of the population enjoying these incomes had risen from 4.5 per cent. to 10.3 per cent., although again the share of the national income taken by these persons had remained much the same. During the last generation, the average man had doubled his chance of possessing a middle-class income, and had increased by 50 per cent. his (still very small) chance of a millionaire's income.

MR. RAMSBOTTOM said that Sir Josiah Stamp had drawn attention to the general conformity between the changes in the higher incomes and changes in the price level, as shown by his graphs, and some questions had been raised as to the appropriateness of the use of the official cost-of-living index, for this purpose. If, however, it were possible to compile an index number better adapted for measuring the changes in the cost of living of persons with these incomes, he thought the conformity of the two curves would be even more striking. The chief disparities between the two series occurred in 1918-20 and in 1925-29. The cost-of-living index was based on working-class expenditure, and its sharp rise in 1918-20 was largely due to food and clothing, which showed much greater price increases than other commodities. Of these two items, food was weighted, in that index number, in proportions appropriate for working-class families, but not appropriate for higher incomes, for which the correct weighting for food would be much smaller. As regards clothing, the percentage increase between 1914 and 1918 in the qualities bought by working-class families was considerably greater than that in the higher qualities of clothing. Similar factors were operating in 1925-29, and if a cost-of-living index figure existed, more appropriate to persons with the higher incomes referred to, the curve would probably be flatter and more in conformity with income changes in both these periods.

The suggestion had been made that a curve representing the movements of wages should be inserted on the graphs, and some comment had been made on the fact that whereas the higher incomes had fallen sharply in recent years, wages had fallen by only about 5 per cent. Mr. Ramsbottom suggested that if Sir Josiah Stamp contemplated adding any graphs of wages, he would not obtain a true comparison if he utilized only figures relating to wage rates for a full week's work. It was true that rates of wages had fallen by only about 5 per cent., on average, between 1929 and 1933, but figures of actual earnings would show a much greater fall. He imagined that if allowance were made for the effect of unemployment, the curve of

actual weekly earnings would have fallen by 1933 to a point not much above the figure of something like 80 shown by the curve of the higher incomes.

MR. MACROSTY said that before putting the vote of thanks to the meeting, there were one or two points arising out of the discussion upon which he would like to comment. The first was on the use of the wholesale price index number for comparison with the statistics of incomes. Might he suggest that Sir Josiah would be fully justified in saying that he took that number because it was out of the wholesale prices that the great bulk of the larger incomes arose, and that therefore the comparison was strictly in order.

The second point to which he wished to draw attention—and here he differed from other speakers in that he was not asking for anything more—was to suggest that those interested in the paper should try to do something for themselves. The data were all before them. Mr. Macrosty objected rather strongly to using, as a standard of comparison with other series, a price series which ran right through the Great War with all its terrible vagaries of prices. He knew that it was tempting to get as long a series as possible, but something useful could be learnt if one took Table VIII, for example, and began at the point where prices got down to a regular and not a fantastic series—from about 1923 or 1924. If one then on those 12 years—which was a much shorter series than he cared to deal with,—correlated the index number with the four series of incomes, a very close correlation would be obtained from the actual amounts, not merely a correlation of the points of change, and a greater influence of prices on the lower ranges of incomes was shown than on the higher. He suggested that Fellows should work this out for themselves and extend it right down to the £2,000 limit. There they would have to do all the calculations afresh, to take the whole of the figures of the £2,000 for those 12 years, calculate out the correlations and communicate the results to Sir Josiah Stamp. If two or three did it, and the results agreed, it would save him the trouble of going over it himself.

There was one other puzzling point in the paper, about the 10,000th man or the 25,000th man. In successive years he was not the same man, and his income might be derived in a different way; its composition might be entirely different, and the effect of price changes on it might be entirely different also. If the 25,000th man one year was a lawyer and the next a motor manufacturer, and the next a mine-owner, then a multiple shopkeeper, all these people would be differently affected by changes in price, and could a series be constructed out of these varying men?

Sir Josiah had conducted an arduous investigation into the incomes of a small fraction of the population, regarding whom alone a great deal of information had been given by the Inland Revenue authorities. With regard to the rest of the population no information as to the distribution of income was given. Surely it was high time that the Treasury should be required to give the distribution of incomes right down to the lower Income Tax limit.



Mr. Macrosty said he had great pleasure in putting the vote of thanks to Sir Josiah Stamp for his interesting paper.

SIR JOSIAH STAMP, in reply: I am much obliged to you for the great interest you have taken in what must have been one of the duller papers ever given to the Society, but I will take advantage of the usual course of commenting on the discussion in the *Journal*. There are one or two points, however, that I will make before we disperse.

The main point made by Sir William Beveridge was a comparison of the rates of fall, and he could not understand why I should say that the income fall was greater than could be accounted for by the price fall. The Sauerbeck index number has fallen from 100 to 66. I say Sir William has forgotten what I have established as to the ratio of variation, and that it is about one half for incomes. If you tell me the Sauerbeck index has fallen to 66, I suggest that the fall in a particular income ought to be a half of that, viz. to about 83. I find it has actually fallen to 72; therefore I say the income has fallen more than I expected under the influence of price alone.

Many comments have been made because this paper is not something different from what it is—because, for example, I have not included a money wage curve. I would have done so if I knew it, and I shall be happy to put in the 1000th man if Professor Bowley will put in the wage curve! Is it a wage rate, or wage earnings? Does it embrace unemployment? Is it a total pay-roll? I gather that unemployment and wage rates are to a certain extent correlated, and I should prefer to take the wage earnings, but I do not know the figures over the period, and I do not believe Professor Bowley does!

I put these figures together with the idea that you should all do sums on them. The number of sums you can do and the figures you can test are almost infinite; I know that they only refer to a limited section of the incomes, but the other figures simply do not exist. The lower incomes were given by a special effort in the Royal Commission on Income Tax in 1920, and I have no doubt that the Inland Revenue may find a way of presenting them in future, but at the moment they do not exist.

I am glad Doctor Marschak has elaborated the proceedings on the mathematical side, because I think there are various matters that are capable of a broad test; the figures are rough and blurred, and we cannot be too precise. In reply to Mr. Clark, the year of assessment was used, and not the year of price, but I have brought the year of price into line by putting the two peaks together without attempting to establish the *exact* lag in fact. The income series is roughly one year advanced.

I used the wholesale price index; none of the others will give very different results. Two things were continually being confused; in the discussion it is the wholesale price index that on the whole *makes* these large incomes; what you do with them afterwards when you come to spend them is the cost of living question, and is another problem altogether. It is an interesting speculation, but if we sug-

gest there is a causal relation between prices and incomes, then there is no great shame in using a wholesale price index. I have received a letter from Mr. Percy Wallis, who says I am all wrong, and that it is the high incomes that make the high prices; it can be taken that way if you like, and will not affect the correlations established. It would affect the title. To avoid tendentiousness I thought of wording it "Concurrent Deviations between the Income and Price Levels," but I knew that that would be regarded as a fearsome title, and therefore I asserted roughly that it is the change in prices that causes the change in incomes, and indeed I still think it is.

Sir Josiah subsequently added the following note:—

I have made the best bricks I can with the amount and kind of straw available. Some speakers ask me for other bricks without any straw (*e.g.* statistics of lower incomes), or different kinds of bricks with this straw (*e.g.* comparisons with wages). But in a paper like this, wherever one stops, there is always a corner just ahead that people would like us to round because it promises some new view. I cannot in an addendum embark on a new paper. But Professor Bowley's appeal for the details of the 100th man is quite reasonable, for it falls strictly within the data, and I give the particulars now worked out hereunder.

Year.				Computed income of 100th person.	Index based on 3 years' average, 1922/3-1924/5. (1927,530 = 100).
1911-12	...	...	...	23,885	64
12-13	...	...	...	24,775	66
13-14	...	...	...	25,750	69
14-15	...	...	...	27,160	72
15-16	...	...	...	25,645	68
16-17	...	...	...	27,790	74
17-18	...	...	...	31,665	84
18-19	...	...	...	33,335	89
1919-20	...	...	...	36,685	98
20-21	...	...	...	41,025	109.3
21-22	...	...	...	41,080	109.4
22-23	...	...	...	36,855	98
23-24	...	...	...	37,800	100.7
24-25	...	...	...	37,935	101.1
25-26	...	...	...	37,745	100.6
26-27	...	...	...	36,545	97
27-28	...	...	...	35,185	94
28-29	...	...	...	35,860	96
1929-30	...	...	...	36,625	98
30-31	...	...	...	35,835	95
31-32	...	...	...	32,435	86
32-33	...	...	...	28,555	76
33-34	...	...	...	26,725	71
34-35	...	...	...	25,805	69

The coefficient of correlation with the cost of living index is $+0.901 \pm 0.026$; and with the wholesale price index $+0.807 \pm$

0.048 or $\pm 0.869 \pm 0.033$ for the two series together. These figures are higher than those for the 10,000th and 25,000th incomes.

The coefficient of Concurrent Deviations is $\pm 0.692 \pm 0.073$ in each case, or $\pm 0.752 \pm 0.061$ for the two series together, or the same as for the 10,000th income.

Professor Jones suggests that the higher the income, the larger the proportion due to speculative investment. I think the estate duty figures confirm the view that business profits enter more largely into the highest figures. Professor Clay is also probably right in suggesting that *earned incomes* make their presence felt a little higher in the scale of later years. Dr. Marschak assumed that the Gibrat formula was used for smoothing, but this had actually not been done. Mr. Macrosty raised an important and baffling point when he suggested that there is an unreality about the concept of the 10,000th man, who might change from year to year in the character of the constituents of his income. But the same could be said about any percentile. The answer is that if the 10,000th man in year x had 80 per cent. fluctuating income and 20 per cent. non-fluctuating, and the 10,001st and 9999th had 20 per cent. fluctuating and 80 per cent. non-fluctuating, they certainly *would* change their relative positions in the very different year y . But to follow the *particular man* would be (a) practically impossible, and (b) transfer the problem to following the fortunes of "any rich man" with a certain proportion of the two kinds of income in the year x , regardless of his lack of business success or his windfalls in other years. It is less artificial to follow a modal composition of income at a particular level of wealth, as the method adopted virtually does.

In these "altitudes" of income, the Pareto line is rather wavering or unstable, and the value of α has first been calculated for the slope between the two points in the statistics between which the 1000th income actually falls. Then α_1 has been computed for the "bracket" next below, and applied to the same statistics. The average of the two computations has then been taken for the table above. In fourteen years the difference is under £150, and it is never very great.

The standard computations for the series are :

Average deviation 13.04 (compared with 17.25 for cost of living index and 25 for wholesale price index).

Standard deviation 14.4 (compared with 21.58 and 32.83, respectively for the indices).

It will be seen that these variations are actually *less* than those of the 10,000th man, and approximate more closely to those of the 25,000th man.

As a result of the ballot taken during the meeting the candidates named below were elected Fellows of the Society :—

Kalidas Mitra.

Hector Muhamed Abdul Razack.

Geoffrey Lloyd Sowerbalts.

ENGLISH DEATH-RATES, PAST, PRESENT AND FUTURE.

A VALEDICTORY ADDRESS.

By MAJOR GREENWOOD, D.Sc., F.R.C.P., F.R.S.

Given before the ROYAL STATISTICAL SOCIETY, June 16th, 1936, the RT. HON.
LORD KENNET OF THE DENE, P.C., G.B.E., D.S.O., D.S.C. in the Chair.

IT is not usual for a retiring president to add to the chronicle of events given by the Council. I ask your indulgence for a breach of custom. To others here beside myself the passing of Karl Pearson is something more than the death of a distinguished veteran. I saw him for the first time in 1902, and since then there can hardly have been a day in which some thought of Karl Pearson has not passed through my mind, and there have been long periods when what he did, advised or suggested was a dominant motive. In youth and manhood a word of encouragement from him has made me glow with pride or a rebuke redden with shame. Even now, nearer sixty than fifty, I cannot, emotionally, picture to myself any other man as of his intellectual stature, or hear him spoken of slightly without a childish feeling of rage. Some of us here owe to him an ideal, an unshakeable faith in the possibilities of human reason. If there were all, and more than all, the defects in his intellectual work which critics, far more competent than I, think they have discovered, it would not lessen the debt some of us owe him.

Karl Pearson was not of our Society; his abstention was a great loss to us, and perhaps some loss to him. I do not know that we had anything to teach him, but we had something he might have enjoyed with us; he could hardly have been more respected; had he moved in a wider circle, he might have been more loved.

But, if our Society one day has a comely house of its own, I hope that our successors will imitate a still more famous learned Society paying tribute to a not less famous man: that they will set up in a place of honour a bust of Karl Pearson and inscribe upon it: *Rien ne manque à sa gloire, il manquait à la nôtre.*

In a valuable paper read here 18 months since, Dr. E. C. Snow said, with his usual wisdom, that a descriptive, statistical history of our declining death-rates, bringing out their association with hygienic and medical advances, would be enlightening. Dr. Snow added, with less than his usual veracity, that I was competent to write such a history. It is not modesty which prompts a disclaimer; I do not believe that *anybody* could write the history Dr. Snow

would like to have; no individual has enough knowledge. Possibly a committee of experts might have a sufficient stock of knowledge, but it would need a literary genius to write their report. However, if I cannot do what Dr. Snow asks, I have one qualification for making an attempt, viz. an interest in the subject. I have often mused over the history of our death-rates; wondered what they will be in the impenetrable future, what they were in the not much more penetrable past. We know what the rates have been during a period which can be completely covered by a single long life; before and after is darkness.

Some of us are curious about the past, all of us are curious about the future. We can but speculate.

A valedictory address is an appropriate vehicle of speculations. It may not be criticized—at least in our Journal—and it is read on the eve of the long vacation. I shall not be openly rebuked for lack of scientific precision, and I may prompt others to indulge in reveries of past, present and future, in those hours when rigorous scientific work is not a duty. I should like to think that my last official act may have such pleasant associations.

The General Facts.

The certainties of our mortality rates are contained in the Tables I and II. Even ninety years ago registration of deaths was pretty complete. The rates of mortality at ages were less reliable then than now, because fewer people had exact knowledge of their ages and more people mis-stated their ages in census enumerations. That error may affect rates of mortality of women in early middle life and of all people in late life. It is probable that in early middle life people like to under-state their ages, and in later life there may be some ambition to figure as the oldest inhabitant.* But it is not very rash to think that the general rates of mortality have been comparable throughout the ninety odd years for which they are given.

Throughout the period there has been change, epidemiological and social, but only of the quinquennium 1916–20 can we postulate a real discontinuity; the concurrence of a great war and a great pestilence.

Regarding these figures then as fairly comparable arithmetical statements, the contrast between 1841–5 and 1931–5 is sufficiently striking; at every age and in both sexes mortality has declined.

* See footnote to p. xxvii of Suppl. to 75th Annual Report of the Registrar-General. Part III.

Perhaps the mortality rates at other ages in the earlier decennia are understated.

TABLE I.

Males.

Quinquennial Death-Rates at Ages.

Period.	All Ages (Standardized).*	0—	5—	10—	15—	20—	25—	35—	45—	55—	65—	75—	85 and upwards.	Deaths under 1 year per 1,000 Live- births.
1841-45	21.6	68.7	8.8	4.8	6.8	9.0	9.4	12.2	17.2	30.3	65.5	143.7	305.1	162
1846-50	23.4	73.7	9.5	5.4	7.4	10.0	10.5	13.6	19.2	33.2	69.5	152.9	319.5	172
1851-55	22.7	73.9	8.8	5.2	7.0	9.2	10.0	12.9	18.6	31.6	66.7	150.9	310.9	172
1856-60	21.6	71.5	8.3	4.6	6.4	8.4	9.2	12.2	17.5	30.4	64.3	142.7	305.3	166
1861-65	22.6	74.1	8.5	4.7	6.4	8.6	9.8	13.2	18.9	32.8	66.1	145.9	316.6	166
1866-70	22.6	72.9	7.9	4.3	6.0	8.3	10.1	13.7	19.6	33.5	67.8	148.7	313.5	170
1871-75	22.4	69.9	7.1	4.0	5.7	8.1	10.0	14.3	20.3	34.8	70.1	149.6	323.3	167
1876-80	21.3	67.1	6.3	3.4	4.8	6.7	8.7	13.4	19.8	34.9	69.4	152.2	331.5	159
1881-85	20.1	61.3	5.8	3.2	4.5	6.0	8.2	12.8	19.3	34.2	68.8	145.4	297.9	152
1886-90	20.0	61.9	4.9	2.8	4.1	5.5	7.4	12.1	19.4	35.2	72.1	147.9	313.7	159
1891-95	20.0	62.9	4.5	2.6	4.0	5.2	7.1	11.9	19.5	35.8	72.5	149.2	290.8	165
1896-1900	19.1	62.4	4.1	2.3	3.6	4.9	6.5	11.1	18.4	34.1	68.3	143.1	282.8	170
1901-05	17.4	54.7	3.7	2.1	3.2	4.4	5.9	9.7	17.0	32.4	65.3	137.6	274.6	151
1906-10	15.8	45.1	3.3	2.0	3.0	4.0	5.3	8.6	15.5	31.2	64.4	137.7	283.0	129
1911-15 †	15.1	40.9	3.4	2.0	3.0	4.0	5.1	9.1	14.9	30.2	64.1	139.2	281.6	121
1916-20 †	15.1	34.4	3.8	2.4	3.9	6.6	8.6	9.1	14.0	27.9	63.0	139.4	267.8	101
1921-25	12.1	27.3	2.5	1.7	2.6	3.5	4.1	6.5	11.6	24.8	58.6	136.2	271.6	86
1926-30	11.5	23.2	2.5	1.6	2.6	3.2	3.7	6.2	11.7	24.0	59.7	137.6	293.6	77

* The standardized death-rates are those which would have been recorded if the sex and age constitution of the population had been the same as in 1901.

† Including civilian mortality only in 1915-20.

TABLE II.
Females.

Quinquennial Death-Rates at Ages.

Period.	All Ages (68 and under 14),	0.	5.	10.	15.	20.	25.	30.	35.	40.	45.	50.	55 and upwards.	70.	75.	80.	85.	90.	95.	100.	105.	110.	115.	120.	125.	130.	135.	140.	145.	150.	155.	160.	165.	170.	175.	180.	185.	190.	195.	200.	205.	210.	215.	220.	225.	230.	235.	240.	245.	250.	255.	260.	265.	270.	275.	280.	285.	290.	295.	300.	305.	310.	315.	320.	325.	330.	335.	340.	345.	350.	355.	360.	365.	370.	375.	380.	385.	390.	395.	400.	405.	410.	415.	420.	425.	430.	435.	440.	445.	450.	455.	460.	465.	470.	475.	480.	485.	490.	495.	500.	505.	510.	515.	520.	525.	530.	535.	540.	545.	550.	555.	560.	565.	570.	575.	580.	585.	590.	595.	600.	605.	610.	615.	620.	625.	630.	635.	640.	645.	650.	655.	660.	665.	670.	675.	680.	685.	690.	695.	700.	705.	710.	715.	720.	725.	730.	735.	740.	745.	750.	755.	760.	765.	770.	775.	780.	785.	790.	795.	800.	805.	810.	815.	820.	825.	830.	835.	840.	845.	850.	855.	860.	865.	870.	875.	880.	885.	890.	895.	900.	905.	910.	915.	920.	925.	930.	935.	940.	945.	950.	955.	960.	965.	970.	975.	980.	985.	990.	995.	1000.	1005.	1010.	1015.	1020.	1025.	1030.	1035.	1040.	1045.	1050.	1055.	1060.	1065.	1070.	1075.	1080.	1085.	1090.	1095.	1100.	1105.	1110.	1115.	1120.	1125.	1130.	1135.	1140.	1145.	1150.	1155.	1160.	1165.	1170.	1175.	1180.	1185.	1190.	1195.	1200.	1205.	1210.	1215.	1220.	1225.	1230.	1235.	1240.	1245.	1250.	1255.	1260.	1265.	1270.	1275.	1280.	1285.	1290.	1295.	1300.	1305.	1310.	1315.	1320.	1325.	1330.	1335.	1340.	1345.	1350.	1355.	1360.	1365.	1370.	1375.	1380.	1385.	1390.	1395.	1400.	1405.	1410.	1415.	1420.	1425.	1430.	1435.	1440.	1445.	1450.	1455.	1460.	1465.	1470.	1475.	1480.	1485.	1490.	1495.	1500.	1505.	1510.	1515.	1520.	1525.	1530.	1535.	1540.	1545.	1550.	1555.	1560.	1565.	1570.	1575.	1580.	1585.	1590.	1595.	1600.	1605.	1610.	1615.	1620.	1625.	1630.	1635.	1640.	1645.	1650.	1655.	1660.	1665.	1670.	1675.	1680.	1685.	1690.	1695.	1700.	1705.	1710.	1715.	1720.	1725.	1730.	1735.	1740.	1745.	1750.	1755.	1760.	1765.	1770.	1775.	1780.	1785.	1790.	1795.	1800.	1805.	1810.	1815.	1820.	1825.	1830.	1835.	1840.	1845.	1850.	1855.	1860.	1865.	1870.	1875.	1880.	1885.	1890.	1895.	1900.	1905.	1910.	1915.	1920.	1925.	1930.	1935.	1940.	1945.	1950.	1955.	1960.	1965.	1970.	1975.	1980.	1985.	1990.	1995.	2000.	2005.	2010.	2015.	2020.	2025.	2030.	2035.	2040.	2045.	2050.	2055.	2060.	2065.	2070.	2075.	2080.	2085.	2090.	2095.	2100.	2105.	2110.	2115.	2120.	2125.	2130.	2135.	2140.	2145.	2150.	2155.	2160.	2165.	2170.	2175.	2180.	2185.	2190.	2195.	2200.	2205.	2210.	2215.	2220.	2225.	2230.	2235.	2240.	2245.	2250.	2255.	2260.	2265.	2270.	2275.	2280.	2285.	2290.	2295.	2300.	2305.	2310.	2315.	2320.	2325.	2330.	2335.	2340.	2345.	2350.	2355.	2360.	2365.	2370.	2375.	2380.	2385.	2390.	2395.	2400.	2405.	2410.	2415.	2420.	2425.	2430.	2435.	2440.	2445.	2450.	2455.	2460.	2465.	2470.	2475.	2480.	2485.	2490.	2495.	2500.	2505.	2510.	2515.	2520.	2525.	2530.	2535.	2540.	2545.	2550.	2555.	2560.	2565.	2570.	2575.	2580.	2585.	2590.	2595.	2600.	2605.	2610.	2615.	2620.	2625.	2630.	2635.	2640.	2645.	2650.	2655.	2660.	2665.	2670.	2675.	2680.	2685.	2690.	2695.	2700.	2705.	2710.	2715.	2720.	2725.	2730.	2735.	2740.	2745.	2750.	2755.	2760.	2765.	2770.	2775.	2780.	2785.	2790.	2795.	2800.	2805.	2810.	2815.	2820.	2825.	2830.	2835.	2840.	2845.	2850.	2855.	2860.	2865.	2870.	2875.	2880.	2885.	2890.	2895.	2900.	2905.	2910.	2915.	2920.	2925.	2930.	2935.	2940.	2945.	2950.	2955.	2960.	2965.	2970.	2975.	2980.	2985.	2990.	2995.	3000.	3005.	3010.	3015.	3020.	3025.	3030.	3035.	3040.	3045.	3050.	3055.	3060.	3065.	3070.	3075.	3080.	3085.	3090.	3095.	3100.	3105.	3110.	3115.	3120.	3125.	3130.	3135.	3140.	3145.	3150.	3155.	3160.	3165.	3170.	3175.	3180.	3185.	3190.	3195.	3200.	3205.	3210.	3215.	3220.	3225.	3230.	3235.	3240.	3245.	3250.	3255.	3260.	3265.	3270.	3275.	3280.	3285.	3290.	3295.	3300.	3305.	3310.	3315.	3320.	3325.	3330.	3335.	3340.	3345.	3350.	3355.	3360.	3365.	3370.	3375.	3380.	3385.	3390.	3395.	3400.	3405.	3410.	3415.	3420.	3425.	3430.	3435.	3440.	3445.	3450.	3455.	3460.	3465.	3470.	3475.	3480.	3485.	3490.	3495.	3500.	3505.	3510.	3515.	3520.	3525.	3530.	3535.	3540.	3545.	3550.	3555.	3560.	3565.	3570.	3575.	3580.	3585.	3590.	3595.	3600.	3605.	3610.	3615.	3620.	3625.	3630.	3635.	3640.	3645.	3650.	3655.	3660.	3665.	3670.	3675.	3680.	3685.	3690.	3695.	3700.	3705.	3710.	3715.	3720.	3725.	3730.	3735.	3740.	3745.	3750.	3755.	3760.	3765.	3770.	3775.	3780.	3785.	3790.	3795.	3800.	3805.	3810.	3815.	3820.	3825.	3830.	3835.	3840.	3845.	3850.	3855.	3860.	3865.	3870.	3875.	3880.	3885.	3890.	3895.	3900.	3905.	3910.	3915.	3920.	3925.	3930.	3935.	3940.	3945.	3950.	3955.	3960.	3965.	3970.	3975.	3980.	3985.	3990.	3995.	4000.	4005.	4010.	4015.	4020.	4025.	4030.	4035.	4040.	4045.	4050.	4055.	4060.	4065.	4070.	4075.	4080.	4085.	4090.	4095.	4100.	4105.	4110.	4115.	4120.	4125.	4130.	4135.	4140.	4145.	4150.	4155.	4160.	4165.	4170.	4175.	4180.	4185.	4190.	4195.	4200.	4205.	4210.	4215.	4220.	4225.	4230.	4235.	4240.	4245.	4250.	4255.	4260.	4265.	4270.	4275.	4280.	4285.	4290.	4295.	4300.	4305.	4310.	4315.	4320.	4325.	4330.	4335.	4340.	4345.	4350.	4355.	4360.	4365.	4370.	4375.	4380.	4385.	4390.	4395.	4400.	4405.	4410.	4415.	4420.	4425.	4430.	4435.	4440.	4445.	4450.	4455.	4460.	4465.	4470.	4475.	4480.	4485.	4490.	4495.	4500.	4505.	4510.	4515.	4520.	4525.	4530.	4535.	4540.	4545.	4550.	4555.	4560.	4565.	4570.	4575.	4580.	4585.	4590.	4595.	4600.	4605.	4610.	4615.	4620.	4625.	4630.	4635.	4640.	4645.	4650.	4655.	4660.	4665.	4670.	4675.	4680.	4685.	4690.	4695.	4700.	4705.	4710.	4715.	4720.	4725.	4730.	4735.	4740.	4745.	4750.	4755.	4760.	4765.	4770.	4775.	4780.	4785.	4790.	4795.	4800.	4805.	4810.	4815.	4820.	4825.	4830.	4835.	4840.	4845.	4850.	4855.	4860.	4865.	4870.	4875.	4880.	4885.	4890.	4895.	4900.	4905.	4910.	4915.	4920.	4925.	4930.	4935.	4940.	4945.	4950.	4955.	4960.	4965.	4970.	4975.	4980.	4985.	4990.	4995.	5000.	5005.	5010.	5015.	5020.	5025.	5030.	5035.	5040.	5045.	5050.	5055.	5060.	5065.	5070.	5075.	5080.	5085.	5090.	5095.	5100.	5105.	5110.	5115.	5120.	5125.	5130.	5135.	5140.	5145.	5150.	5155.	5160.	5165.	5170.	5175.	5180.	5185.	5190.	5195.	5200.	5205.	5210.	5215.	5220.	5225.	5230.	5235.	5240.	5245.	5250.	5255.	5260.	5265.	5270.	5275.	5280.	5285.	5290.	5295.	5300.	5305.	5310.	5315.	5320.	5325.	5330.	5335.	5340.	5345.	5350.	5355.	5360.	5365.	5370.	5375.	5380.	5385.	5390.	5395.	5400.	5405.	5410.	5415.	5420.	5425.	5430.	5435.	5440.	5445.	5450.	5455.	5460.	5465.	5470.	5475.	5480.	5485.	5490.	5495.	5500.	5505.	5510.	5515.	5520.	5525.	5530.	5535.	5540.	5545.	5550.	5555.	5560.	5565.	5570.	5575.	5580.	5585.	5590.	5595.	5600.	5605.	5610.	5615.	5620.	5625.	5630.	5635.	5640.	5645.	5650.	5655.	5660.	5665.	5670.	5675.	5680.	5685.	5690.	5695.	5700.	5705.	5710.	5715.	5720.	5725.	5730.	5735.	5740.	5745.	5750.	5755.	5760.	5765.	5770.	5775.	5780.	5785.	5790.	5795.	5800.	5805.	5810.	5815.	5820.	5825.	5830.	5835.	5840.	5845.	5850.	5855.	5860.	5865.	5870.	5875.	5880.	5885.	5890.	5895.	5900.	5905.	5910.	5915.	5920.	5925.	5930.	5935.	5940.	5945.	5950.	5955.	5960.	5965.	5970.	5975.	5980.	5985.	5990.	5995.	6000.	6005.	6010.	6015.	6020.	6025.	6030.	6035.	6040.	6045.	6050.	6055.	6060.	6065.	6070.	6075.	6080.	6085.	6090.	6095.	6100.	6105.	6110.	6115.	6120.	6125.	6130.	6135.	6140.	6145.	6150.	6155.	6160.	6165.	6170.	6175.	6180.	6185.	6190.	6195.	6200.	6205.	6210.	6215.	6220.	6225.	6230.	6235.	6240.	6245.	6250.	6255.	6260.	6265.	6270.	6275.	6280.	6285.	6290.	6295.	6300.	6305.	6310.	6315.	6320.	6325.	6330.	6335.	6340.	6345.	6350.	6355.	6360.	6365.	6370.	6375.	6380.	6385.	6390.	6395.	6400.	6405.	6410.	6415.	6420.	6425.	6430.	6435.	6440.	6445.	6450.	6455.	6460.	6465.	6470.	6475.	6480.	6485.	6490.	6495.	6500.	6505.	6510.	6515.	6520.	6525.	6530.	6535.	6540.	6545.	6550.	6555.	6560.	6565.	6570.	6575.	6580.	6585.	6590.	6595.	6600.	6605.	6610.	6615.	6620.	6625.	6630.	6635.	6640.	6645.	6650.	6655.	6660.	6665.	6670.	6675.	6680.	6685.	6690.	6695.	6700.	6705.	6710.	6715.	6720.	6725.	6730.	6735.	6740.	6745.	6750.	6755.	6760.	6765.	6770.	6775.	6780.	6785.	6790.	6795.	6800.	6805.	6810.	6815.	6820.	6825.	6830.	6835.	6840.	6845.	6850.	6855.	6860.	6865.	6870.	6875.	6880.	6885.	6890.	6895.	6900.	6905.	6910.	6915.	6920.	6925.	6930.	6935.	6940.	6945.	6950.	6955.	6960.	6965.	6970.	6975.	6980.	6985.	69
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* The standardized death-rates are those which would have been recorded if the sex and age constitution of the population had been the same as in 1901.

When the historical sequence is examined, it is seen that improvement was slowest at the earliest and the latest ages. Mortality at ages between 5 and 20 years was already declining before 1870, a decennium later the rates between the ages of 20 and 35 years had improved. One could hardly say that the rate at 35-45 had moved downwards decisively before the early eighties, or that at ages 45-55 until the turn of the century. In old age, improvement is even now barely perceptible. Improvement at the beginning of life was as long delayed as that in later middle age or old age; but when it came it came with a rush.

This general impression of a wave of improvement passing along the ages from 5-10 is still more striking when a particular cause of death is chosen, viz. mortality from pulmonary tuberculosis. The Registrar-General, speaking of this topic in the 3rd Part of the Decennial Supplement for 1921 said (p. cv):—

“ This change continues a tendency to which attention was drawn in the ‘ supplement ’ for 1901-10, towards postponement to a higher age of the period of greatest decline of adult mortality. (Supplement to the 75th Annual Report of the Registrar-General, Part III, p. lxxi.) For males this has moved from 20-25 in 1881-90 to 45-55 in 1911-20, and for females from 20-25 in 1881-90 to 55-65 in 1911-20. Thus throughout these four decades a single generation of both males and females—those born somewhere about 1860—appears to have contributed more than any other to the reduction of mortality which has occurred.”

It is the movement expressed by these fundamental statistical data which all of us, statesmen, physicians, simple citizens, would like to understand.

Over the period covered by these statistics there have been great changes, some of which can and some cannot be expressed by numbers.

Our population has become increasingly a town population. Over the first half of the last century an exact measure of urbanization is not available. But between 1801 and 1851 the proportion of the people living in the country or in towns with less than 20,000 inhabitants declined from 77·0 per cent. to 66·4 per cent. Since 1851 the percentage enumerated in urban districts is a reasonably comparable index. Between 1851 and 1931 it increased from 50·2 per cent. to 80·1 per cent. (the percentages at successive enumerations were 50·2, 54·6, 61·8, 67·9, 72·0, 77·0, 80·0, 80·4, 80·1). The rate of increase was greatest between 1861 and 1871, and the proportion has remained nearly constant over the last twenty years.

As, in British experience, mortality rates at most ages have been lower in rural than in urban districts, it was natural that the increasing urbanization of the country should be expected to influence rates of mortality. Farr attributed the practically stationary rate of general mortality throughout his official life to the growth of towns. In his opinion, general improvements of hygiene were not reflected in the rates of mortality of England and Wales because an increasing proportion of the people lived in towns. The influence of density of population upon mortality was one of his favourite topics and Farr interpreted this contrast in terms of density. In the supplement to the 35th Annual Report he gave a table comparing the mortality rates at ages in groups of districts of different types with those of the "Healthy Districts" (mostly small rural areas). Manchester District exceeded the standard by 196 per cent. at ages under five and by 131.3 per cent. at ages 5-10. At ages 15-20 and 20-25 the excesses were only 49.7 per cent. and 40.2 per cent. and at 75-85 and over 85, 48.3 per cent. and 22.9 per cent. But at 35-45 and 45-55 the excesses were 149.3 per cent. and 144.4 per cent. In London and in Liverpool Districts the trends were the same, although in London the excess was much smaller (actually no excess at all at ages 15-25) and in Liverpool it was much greater. He remarked:—

"The exposure of children, of men and women in the prime of life, and of old people to causes of death, varies in different circumstances; but it is evident, after every allowance has been made, that the power of resisting the noxious influences at work in the thickest peopled districts is greatest at puberty, least in childhood and in manhood."

Several years before (in the 23rd Annual Report) he had written:—

"Although the time may be distant when cities will be as healthful as rural districts, or the inferiority which our English poet ascribes to 'the town' as the handiwork of man becomes much less apparent in point of salubrity than it is at present, it cannot be questioned that large populations have even now advantages of a nature favourable to health which villages do not possess. The highest attainable health is probably to be sought in a happy combination of both states—*rus in urbe*."

That the contrast of urban with rural mortality is not the same at different ages, suggested by the quotation I have just made, was more fully demonstrated first by the Swedish statistician Sundbärg, but has been pointed out with particular reference to our own country by Dr. Stevenson.

An agricultural state has an absolute or relative advantage in infancy and at middle age and old age, an absolute or relative disadvantage in later childhood, adolescence and early adult life. The contrasting mortality rates of Sweden and England and Wales have often been used to illustrate the point, but it can be as well shown by intra-national comparisons. In our own generation and in our own country, if the All-England rates at ages are taken as 100, then at age 0-5 in the decennium 1911-20 the rates of mortality (males) of county boroughs and rural districts were respectively 120 and 74. At 5-15 the former was 113, the latter 83. At 15-25 the figures are 108 and 91, the closest approximation of the two series, until we come to the oldest age 75—(113 and 95). The maximum divergence, after infancy, is at ages 45-55, for which the county boroughs figure is 118, the rural districts figure 73. For females, the results are similar.

These are changes and contrasts readily expressible in a statistical form. Others not less important cannot be so expressed. Indeed, they cannot even be described, because if one *knew* what were the relevant facts, there would be no problem to solve. I can only pick out those changes which seem to *me* important.

First I should put that general, social progress which we speak of as an improved standard of living. On the whole, our people have increasingly enjoyed more of the creature comforts of life throughout the last ninety years. There have also been improvements in the art and science of preventive and curative medicine. These two orders of events are not distinct. In spite of stoics and ascetics, what is hygienically right is more often than not what is agreeable. It is certainly hygienically right to eat plenty of good food, to work and to play in moderation and to live in a large, well-ventilated and equipped house. It is also pleasant to do so. A great many, perhaps a majority, of hygienic improvements would certainly have been adopted for hedonistic reasons if people had been able to afford them.

The change in the standard of living throughout the Victorian period is the province of the economic historian. I believe I shall offend nobody by saying that, at the beginning of our statistical history, say the first ten years of the old Queen's reign, there was some, but not very much, improvement in the standard of living of the working classes, and that from 1852 to 1870 one had a period of "unexampled progress in industry and commerce, and resultant prosperity in which all classes, except the agricultural labourer shared" (Buer, *Health, Wealth and Population in the early days of Industrial Revolution*; London, 1926, p. 225). From 1870 to the end of the nineteenth century improvement was slower, but con-

tinued. In the twentieth century the industrial supremacy of this nation ceased to be unchallengeable, but the standard of living continued to rise. Even now, in spite of the horrors we have endured and the sufferings we may still have to endure, the *material* standards of living of a great majority of the people are much higher than in those days of "unexampled progress" of which Macaulay and Roebuck boasted in language which Matthew Arnold found to fall short of the best standards of literary taste.

Perhaps, too, one may interpolate an historical note of interrogation. There is no doubt that the population of England and Wales, which increased very slowly in the first three-quarters of the eighteenth century, was increasing rapidly in the last quarter and after the turn of the century; there is very little doubt that this change was a consequence rather of a declining death-rate than an increasing birth-rate. The point has been elucidated by several writers, most clearly by Mr. G. Talbot Griffith (*Population Problems of the Age of Malthus*; Cambridge, 1926). It is not improbable that the crude death-rate fell between 1780 and 1810 from over 29 per 1000 to under 20 per 1000, while the birth-rate never much exceeded 35 per 1000 (about 1790) and then fell somewhat. There is very little doubt that after the end of the French war the death-rate rose, and that it did not again fall until after that great prosperity of which Macaulay and Roebuck boasted. A cynical vital statistician of the late fifties *might* have said that in the bad, immoral times at the end of the eighteenth century, when the "people" were exploited politically by owners of rotten boroughs and industrially by legislatively unfettered employers, they at least did not die at such high rates as under Good Queen Victoria. *Why* they did not, is the note of interrogation. Is it possible that without legislative expression there *was* a great change, a silent revolution? Miss Buer has collected some evidence on the point. Those of us who take pleasure in reading diaries see, or think we see, that the men and women living at the end of the eighteenth century were kinder people than their grandparents.

Turning to changes in medical and hygienic knowledge, this, I think, is the story.

At the beginning of Queen Victoria's reign the general stock of hygienic knowledge, the attitude of both medical men and laymen towards the prevention of disease, did not differ fundamentally from that of their great-grandparents. What was thought, said and done when cholera came in 1831 differed in no significant way from what was actually thought and said and would have been done if plague had reached England in 1720. The epidemic did not teach the College of Physicians much, but it undoubtedly did

give disease a publicity value, and led to the beginning of a national system for at least trying to control disease. In Simon's classical treatise on English Sanitary Institutions one finds a complete account of the evolution of the system, beginning with the Consultative Board of Health of 1831, proceeding through committees and commissions to the legislation of 1848 and the General Board of Health to the Medical Department of the Privy Council, and finally to the Local Government Board, which expanded in our generation into a Ministry of Health. The legislative landmarks of the nineteenth century were the Public Health Act of 1848 and the consolidating Act of 1875.

This was the evolution of specific hygienic action, but we must take with it changes which were only in part motivated by medical and hygienic arguments; they were more effectively quickened by the growth of humanity which Simon ranked among the "New Momenta" of hygienic progress. Among these was legislative control of industrial conditions. Before the reign of Queen Victoria all such legislation was directed to mitigating the conditions of life of children, little white slaves, and none of it had much practical value until, in 1833, inspection was enacted. Women first received some small measure of protection in 1842 (Mines and Collieries Act), and in 1844 their hours of labour in factories were regulated. The Ten Hours' Act of 1847 did indirectly limit the working hours of adult males. So that children of 5-15 began to receive some protection in 1831-40, adults about 10 years later.

So far as concerns direct hygienic improvements other than limitation of hours of labour, no important legislative expression of reform is to be found before the rather complicated Factory Act of 1867, almost the only nineteenth-century measure in which the influence of scientific research (that of Greenhow) can be distinctly traced. The Metalliferous Mines Regulation Act of 1872 was also partly inspired by research into the ætiology of a particular occupational hazard—miners' phthisis. More than 20 years passed before, in consequence of an Act of 1895, medical notification of certain occupational poisonings and diseases was required and a medical inspector of factories was appointed.

It is worth while to enquire whether the information we now have enables us to confirm or refute Farr's interpretation of the movements of mortality. I have already summarized it, pointing out that he put most weight upon the evils of density in towns which, in his time, overweighted some of the sanitary advantages possessed by towns. By the evils of density he certainly meant those of domestic overcrowding and those of atmospheric pollution. He also stressed the vulnerability of infancy and middle life. We have

seen that advantage in later childhood and youth, disadvantage in infancy and later adult age characterize industrialized, *i.e.* urban states. It is therefore open to us to consider whether the wave-like movement of age mortality, its earlier fall at ages under 20 and its stagnation or retrogression in middle life almost to the end of the nineteenth century might not be explained in Farr's sense, without resort to any other hypothesis. Suppose that throughout the Victorian period improvement in the standard of urban living in the sense of cheaper and more abundant food, medical and hygienic care, were accompanied by stagnation or even retrogression under the articles of housing and atmospheric pollution. Then, I think, Farr would have expected improvement in young age mortality and stagnation or deterioration of later adult age mortality. If, after the turn of the century, there had been rapid improvement of urban housing conditions, some approximation to the *rus in urbe* condition which Farr deemed the ideal, its effect should be seen in a change in the mortality rates of later adult life. Although the housing of the people has been a major issue for almost a century, the statistician must confess that even approximately comparable data cover only the last 40 years. This subject is so intensely controversial that even in a speculative address I hardly venture to touch upon it.

Having considered the evidence available to me, in particular the masterly report issued in the 1931 census series, these are the conclusions I tentatively reach. I think that between Farr's time and the census of 1891 there had been improvement, but not very great improvement, in urban housing. It is impertinent for a statistician to intrude personal impressions, but human to do so. I was born in Shoreditch, and lived there continuously until 1906. My father, a general practitioner of medicine, was keenly interested in the housing problem; hearing him talk about it is among my earliest recollections. I do not think that the Shoreditch of his young days differed very much from the Shoreditch of my school-days in the early nineties. I cannot find much evidence in books that before the census of 1891 great *general* improvements had been made. Between 1891 and 1901 there is censal evidence of great improvement. So far the case looks fair. Between 1891 and 1901 middle-age rates of mortality fell sharply.

But if one compares the censal results of 1901 and 1911, improvement is dubious. The authors of the 1911 report are inclined to attribute the meagre arithmetical evidence of reduction in the proportion of persons housed more than 2 to a room to inaccuracies in the 1901 returns. But, keeping to arithmetic, it is clear that evidence of accelerated improvement, to put it at the lowest, is

meagre, yet between 1901 and 1911 middle-age mortality fell faster than in the previous decade. The census of 1921, if, owing to other demographic factors, it did not mark retrogression, certainly showed no substantial improvement. But middle-age mortality was still falling. In 1931 we have undoubtedly a substantial improvement and we have had a continued decline of mortality.

TABLE III.

Families at Densities of "More than 2 Persons per Room." England and Wales. (P. xxiv of Census Report on Housing, Census of 1931.)

1-4 room occupation.

Census.	Number.	Percentage.
1891	481,653	7.86
1901	392,414	5.58
1911	405,010	5.10
1921	475,789	5.44
1931	384,273	3.76

I do not think the statistical evidence inconsistent with the truth of Farr's hypothesis. I certainly cannot say it proves the hypothesis to be right. So far as the other elements in the density theory are concerned, viz. the question of atmospheric pollution, the greater enjoyment of open air—due to better and cheaper transport—these are matters upon which exact arithmetical judgment is even more difficult than upon the vexed question of housing.

If we briefly summarize the *directions* of change, they were these. The general public health legislation was primarily inspired by the horror aroused by the disgusting accommodation provided for the poorer classes in towns and the general filthiness of even "better-class" conditions. It was accepted as an axiom that filth (undefined) led to disease, and a vigorous campaign against filth began. The factory legislation was inspired by horror of the cruelties endured by children and general belief that factory life stunted the growth of the rising generation. It is fair to say that, although the period of full campaign, say from 1845 to 1875, was also an epoch of fruitful scientific activity in the departments of biology most closely connected with the science of medicine and surgery, the great pioneers of medical biology had very little, if any, influence on public health activities. The theory—in the broadest sense of that term—of such influential reformers as Southwood Smith, John Simon, Edwin Chadwick and Florence Nightingale, was of a child-like simplicity. It would not be too paradoxical to say that if none of the things they caused to be done could be expected to

save a single life, it would still have been right to do nearly all the things they did, simply because the doing of them made the living of life for millions of people less of a hell upon earth. In sum, they made environmental conditions more tolerable, and if keeping "filth" out of food and drink, providing people with less rare opportunities to wash themselves and making provision for the nursing of sick people lengthen lives, they lengthened lives.

It is not part of my theme, but I cannot resist the temptation to say that to make life more livable seems to me quite as worthy a motive for hygienic reform as to make it longer.

Statistical Analysis of the Data.

This has been a tedious but incomplete summary of what I call the general facts. I now return to the statistical problem. Having as our ultimate data the recorded rates of mortality in age-groups over some 90 years, can they be resumed under some scientific law which will permit us to forecast the future? Before we can extrapolate we must graduate; the statistician confronted with a secular series hopes to discover a "formula" which graduates the present series, and with perfect accuracy reproduces its past, before data were collected, and its future for which data do not yet exist. But, as that description, with a few modifications of technical phrasings, would be a theologically acceptable definition of omniscience, the hopes are always frustrated. Nobody expects to extrapolate, forward or backward, more than a very little way. How shall it be done?

To make the discussion of methods as clear as possible, we may as well pretend that the statistical data are available in finer detail than is really obtainable, that we have separate data for each calendar year and for each year of age, so that, say the probability of dying in the year of life x during the calendar year y , q_{xy} , say, is known for a considerable range of both x and y .

I suppose that the data are arranged in a rectangular frame, the ordinate scales, age, the abscissa, secular time, and we will suppose that the unit of secular time is the same as that of age, so that the symbol (s, r) denotes the rate of mortality of men aged s years and born r years from the origin of secular measurement, if that origin is also taken as the origin of individual age measurements. Naturally the argument is unaffected if s means not aged s years, but aged $c + s$ years. In the statistically ideal case, say of the whole secular history of a vanished people, supported wholly by natural increase and having no migration, the diagonals of this rectangle record the age mortalities of different generations. When the population began there would be a number of empty squares

to the left and below, when it died out there would be empty squares to the right and above gradually invading the whole figure.

TABLE IV.
Secular Time.

Years of Age.	0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	...
0	(0, 0)	(0, 1)	(0, 2)	(0, 3)	(0, 4)	(0, 5)	(0, 6)	(0, 7)	(0, 8)	(0, 9)	(0, 10)	...
1		(1, 0)	(1, 1)	(1, 2)	(1, 3)	(1, 4)	(1, 5)	(1, 6)	(1, 7)	(1, 8)	(1, 9)	...
2			(2, 0)	(2, 1)	(2, 2)	(2, 3)	(2, 4)	(2, 5)	(2, 6)	(2, 7)	(2, 8)	...
3				(3, 0)	(3, 1)	(3, 2)	(3, 3)	(3, 4)	(3, 5)	(3, 6)	(3, 7)	...
4					(4, 0)	(4, 1)	(4, 2)	(4, 3)	(4, 4)	(4, 5)	(4, 6)	...
5						(5, 0)	(5, 1)	(5, 2)	(5, 3)	(5, 4)	(5, 5)	...
6							(6, 0)	(6, 1)	(6, 2)	(6, 3)	(6, 4)	...
7								(7, 0)	(7, 1)	(7, 2)	(7, 3)	...
8									(8, 0)	(8, 1)	(8, 2)	...
9										(9, 0)	(9, 1)	...
10											(10, 0)	...
.												...
.												...
.												...

The completed entries would occupy a trapezium. We should have only knowledge of a rectangle cut out of the complete figure, the vertical sides of which would be less than 100 years apart. If we wished to graduate the entries in this rectangular frame, there are three methods we might adopt. (1) We might operate on the rows. The ages of the exposed to risk would be constant from year to year. The variable would be secular time. (2) We might operate on the columns. The deaths of each column would happen in the same secular year, the persons exposed to risk would have been born in different years. (3) We might operate upon the diagonals. The exposed to risk would all have been born in the same year, their exposure to risk of dying at different ages will have occurred in different secular years. Methods (1) and (2) contrast strongly with method (3). In principle, method (1) is simpler than method (2), because from the point of view of the extrapolator it involves fewer operations. Suppose, for instance, that it were really possible to graduate a row with such a function as the logistic, one asymptote of which would be the rate of mortality of a past age, the other the rate of mortality down to which the secular curve is bending. No further operation is needed. But if we graduate a column, we must use some formula which expresses mortality as a function of age, and for extrapolation we must then determine what functions of secular time the parameters of the columnar graduations are. Since the most elaborate statistical comparison of the methods yet made has been a comparison of methods (2) and (3), it deserves precedence. Before, however, discussing the results, it is fitting to consider the presumable advantages

and disadvantages of each. If we could believe (1) that all men and women are, statistically speaking, born equal, (2) that the likelihood that a man will die in the n th year of his age is, again statistically speaking, independent of what happened to him when his age was $n - x$ for all values x from 1 to $n - 1$, then to operate on a row or a column would seem the best course. If babies were like grapes, assumption (1) would plainly be untenable, as all lovers of wine will agree; but they are not very much like grapes. If, as some eugenists hold, the birth-rate is increasingly differential—whether differentiating favourably or unfavourably is immaterial—again the assumption is untenable. I shall not discuss these points; it is enough to note that the assumption is certainly not easily made. The difficulties in accepting (2) are even more formidable. Insurance companies in their business and hospital physicians in their teaching put a good deal of weight on the previous medical history of a proposer or a patient. In using rows or columns in preference to diagonals, we seem to ignore the putative effect of past individual experience. In theory the only justification for such a course would seem to be that the weight of environmental factors immediately operating in time upon the exposed to risk is so much greater in the determination of a rate of mortality than that of past events, that the latter may be ignored. In ascertaining the chances of death of the inhabitants of a town subjected to an air raid, their respective medical histories will not be a factor of much statistical importance. Probably that is nearly true of such strokes of fate as the great plagues of 1348–9 and 1918–19.

Turning to the method of graduating diagonals, which may conveniently be named the *generation* method, and so distinguished from the other two, which are *period* methods, the one obvious objection to it is that if some secular factor wholly or mainly independent of age comes into play, that factor will much more seriously disturb a graduation process applied to diagonals than to columns. If, for instance, the mortality at every age in a particular year of secular time were increased by a constant multiplier, *every* diagonal graduated would show an age discontinuity. The graduation of the affected column would, however, be as smooth as before. It is, of course, difficult to conceive of a secular disturbance which would act in so simple a way; but such an epidemic as that of 1918–19 introduces an analogous discontinuity. It must also be noted that this difficulty, while favourable to the column method against the diagonal method from the point of view of graduation of the observed facts, is an equal difficulty for both from the point of view of extrapolation. On balance, then, *a priori* considerations incline, I think, in favour of the generation and against the period

method. But *a priori* considerations ought to have very little weight in a practical, statistical discussion.

It is perhaps strange that more work has not been done on this subject. National Life Tables, for instance, are always mere graduations of columns, generation life tables have, indeed, been constructed, but hardly attracted serious attention. That, however, is intelligible. A generation life table, standing alone, is of purely historical interest. If, for example, the Government Actuary, instead of preparing a hypothetical table of mortality based on the rates of mortality experienced by contemporaneous lives of different ages in the three years 1920–22, had prepared a generation table based on the fates of those born in 1820–22 (if he could have done so, which he could not because the data do not go back so far), that table would have had only historical interest. The hypothetical table actually prepared is nearer to reality. The expectations of life of the latter may be too small, those of the former must be.* Official documents ought not to be exercises in archaeology or prophecy. But if we do wish to prophesy, it might be that a series of incomplete generation tables would be more useful aids than a series of complete period tables, and that is a question which has been little studied. The most important contribution yet made to the subject is that of H. Cramér and H. Wold. A preliminary account of their work was printed in Vol. 5 (1934) of the *Nordic Statistical Journal*, pp. 64–83, but contained lacunæ; the complete memoir (*Skandinavisk Aktuarietidskrift*, 1935, pp. 161–241) seems to me a model of clear-sighted statistical research, from which I hope to profit, and which I am sorry not to have had in my hands when this paper was roughed out.

The basis of Cramér and Wold's research was the acceptance of the view that, at ages over 30 years, the Makeham–Gompertz formula is a sufficiently exact representation of the relation between age and force of mortality. "We are aware," they write, "of the fact that this formula has sometimes been severely criticized, and we are indeed very far from believing that it represents a universal 'Law of Life.' It does, however, seem sufficiently remarkable that a mathematical expression of this simple structure has proved capable of serving at least as a first approximation to mortality curves of the most varied provenance. Without being prepared to claim for the MAKEHAM constants any definite biological significance, we think it may be safely maintained that generally these constants, if determined by a sufficiently accurate method, sum up essential features of the mortality curve in a very convenient way."

* See Professor Mortara's excellent discussion of the point on p. 219 of *Sommario di Statistica*, Milan, 1931.

Eight years ago (*Journ. Hygiene*, xxviii, 1928, pp. 267-94), I spent some time in studying the biological interpretation of the formula as adumbrated by its inventor, Benjamin Gompertz. It is well known that Gompertz conceived of mortality as generated by two factors, one dependent upon, the other independent of age. Although his thought was directed to the individual phenomena of living, i.e. he supposed that each individual had a characteristic process of senescence and that each man's circumstances of life varied, I think that his formula might still be accepted as a hopeful statistical result. But it seems equally clear that no formula obtained from statistical experience can ever offer a biological separation. I mean that when we compare the graduations of various experiences, the separate terms of $\mu_x = A + Bc^x$ can never be independent measures of the factors of mortality. What a biologist or a hygienist would like to believe is that c measures a physiological characteristic, while A and B measure environmental properties. If c , for instance, measured the resistance—whether genetic or acquired *before* the period of life to which the "law" applies is immaterial—while A and B measured the force of environmental circumstances, then comparison of formulæ might teach us whether when mortality decreases the decrease is due to environmental betterment affecting all ages of life, or to some more subtle influence. We might have two experiences showing the same force of mortality reached by wholly different mechanisms. I do not think the biologist can believe this. However we proceed, whether by generations or periods, we are but determining the arithmetical values of certain "constants" of a simple algebraical formula which graduates a set of figures. The give and take between the terms of the formula will be governed wholly by that condition. Cramér and Wold, for instance, show that whether using generations or periods, c increases, while A and B diminish, but we shall hardly be justified in inferring that the genetic quality (or, alternatively, the environmental experience at ages under 30) of the Swedish people has deteriorated since the birth year 1795, *pari passu* with a striking environmental improvement of B and a smaller improvement of A . Common sense informs us that, since the force of mortality has fallen greatly, it is arithmetically inevitable that if c increased B must have decreased, and, proportionally, to a much greater extent, because a power of c is involved. The fact that the formula without the A term at all was found by Gompertz an effective gradiator over the range of adult ages down to 60 is sufficient evidence that A is *relatively* unimportant. We cannot, I think, read into the Makeham-Gompertz formula any profound biological significance, but must take it, as Cramér and Wold have taken it, as a convenient instru-

ment. The authors have systematically graduated by columns and by diagonals.* The statistical principle invoked was to obtain the constants of any set, whether a column or a diagonal, by an approximation to the rule of minimizing χ^2 . Log c was interpolated or extrapolated by a logistic. B was calculated by the method of moments and interpolated by a logistic fitted to log B . A was determined by minimization when graduated B 's and c 's were used and interpolated by a straight-line or second-order parabola. How far the authors' methods are efficient in the strict sense is a question for those more mathematically expert than I am; as a working statistician, I express my gratitude for the lucidity of the authors' exposition, and their strict adherence to a rule which I should like to see made a *law* of mathematical-statistical publication, viz. to provide complete arithmetical illustrations of the use of methods.

The results of this careful analysis are that while neither period nor generation analysis leads to an agreement between observed and expected deaths which, judged by the value of χ^2 , is good, both methods lead to graduations which do not greatly distort the facts. The following table illustrates this, on three periods and three generations.

TABLE V.

(From Cramér and Wold, *op. cit.*, p. 178.)

Age.	Periods.			Generations.		
	1811-15. $\chi^2 = 50.$	1861-65. $\chi^2 = 64.$	1911-15. $\chi^2 = 26.$	1780. $\chi^2 = 560.$	1810. $\chi^2 = 568.$	1840. $\chi^2 = 101.$
30-40	- 1.6	- 0.7	- 2.1	- 3.5	- 7.2	- 1.4
40-50	+ 3.7	+ 2.5	- 1.4	+ 4.9	+ 9.6	+ 1.2
50-60	- 0.5	+ 1.6	+ 1.8	+ 3.2	+ 3.9	- 0.5
60-70	+ 0.1	- 1.8	- 1.8	- 6.1	- 4.4	- 3.0
70-80	+ 0.6	- 1.1	+ 0.4	- 0.6	- 4.2	+ 2.9
80-90	+ 3.3	+ 3.6	+ 0.0	+ 1.9	+ 3.7	- 2.2

The authors' final conclusion is that "neither graduation seems to deserve to be decidedly preferred to the other."

Passing from graduation to extrapolation, the position is illustrated by the following table. Here I give the observed and graduated values for the quinquennium 1926-30, and the extrapolations for ages over 60 obtained for the quinquennium 1951-5.

* The death-rates have been interpreted as approximate values of the force of mortality, $\mu(x, t)$ for the central age and central calendar year of the "group" (*op. cit.*, p. 172).

TABLE VIa.

*Observed and Graduated Rates of Mortality 1926-30.
Swedish Males (Cramér and Wold).*

Age Group.	Observed Rate per 1000.	Graduated by Periods.	As Percentage of Observed Rate.	Graduated by Generations.	As Percentage of Observed Rate.
30-35	4.40	5.08	115.5	4.31	98.0
35-40	4.77	5.65	118.5	5.17	108.4
40-45	5.85	6.61	113.0	6.36	108.7
45-50	7.70	8.21	106.6	8.12	105.5
50-55	10.12	10.88	107.5	10.82	106.9
55-60	14.58	15.34	105.7	15.10	103.6
60-65	22.21	22.79	102.6	22.04	99.2
65-70	34.00	35.22	103.6	33.49	98.5
70-75	54.09	55.98	103.5	52.53	97.1
75-80	89.24	90.65	101.6	84.58	94.8
80-85	147.49	148.53	100.7	138.44	93.9
85-90	235.28	245.19	104.2	229.83	97.7
		Av. error	6.9%		4.5%

Extrapolations for 1951-5.

Ages.			Periods.	Generations.
60-65	...	...	21.68	20.13
65-70	...	...	34.08	31.48
70-75	...	...	54.78	50.30
75-80	...	...	89.34	81.51
80-85	...	...	147.06	133.90
85-90	...	...	243.42	221.40

It will be seen that while the generation method graduates the data of males better than the period method, it graduates the data of females worse. The deviations are plainly systematic, and the mean percentage errors are considerable, 6.9 and 4.5 for males, 6.6 and 9.8 for females.

I should not feel any great confidence in the extrapolates of either process. It is necessary to remark that this confrontation is rather unfair to a generation method, for technical and material reasons. The technical reason is that, if we work with complete generations, the values given for 1926-30 are partly extrapolations. The material reason is that the occurrence of epidemics, such as the cholera epidemics of the past or the influenza of our own time, must prejudice arithmetically a diagonal method more seriously than a columnar method. In the former the arbitrary deviation of mortality is imported as error into many diagonals; in the latter it is a factor acting, perhaps similarly, upon all the members of a secular column.

TABLE VIb.
Observed and Graduated Rates of Mortality 1926-30.
Swedish Females (Cramér and Wold).

Age Group.	Observed Rate per 1000.	Graduated by Periods.	As Percentage of Observed Rate.	Graduated by Generations.	As Percentage of Observed Rate.
30-35	4.30	5.02	116.7	4.98	115.8
35-40	4.53	5.41	119.4	5.52	121.9
40-45	5.32	6.09	114.5	6.31	118.6
45-50	6.87	7.26	105.7	7.54	109.8
50-55	9.38	9.28	98.9	9.53	101.6
55-60	12.50	12.78	102.2	12.83	102.6
60-65	18.78	18.82	100.2	18.41	98.0
65-70	30.22	29.27	96.9	27.94	92.5
70-75	49.16	47.35	96.3	44.35	90.2
75-80	84.02	78.61	93.6	72.72	86.6
80-85	137.05	132.66	96.8	122.30	89.2
85-90	219.09	226.12	103.2	210.25	96.0
		Av. error	6.6%		9.8%

Extrapolations for 1951-5.

Ages.	Periods.	Generations.
60-65	17.99	17.46
65-70	28.42	26.96
70-75	46.44	43.26
75-80	77.62	71.31
80-85	131.53	119.69
85-90	224.77	203.37

But, as Dr. Ffoliott said, although there may be good reasons why a fig tree is barren, it will remain a barren fig tree. I think the result of this admirable study is to lead us to conclude that, so far as the mortality experience of Sweden is concerned, the generation method does not put the prophet into a seriously better position than the period method. It is, however, well known that the secular evolution of mortality in Sweden differs considerably from that of mortality in England and Wales. Perhaps here a generation method may be more successful. Independently of Cramér and Wold, three British investigators, Kermack, McKendrick and McKinlay, recently published * two papers on a cognate subject, covering a wider field. The principle guiding these investigations can be explained in the following way. Suppose that the rate of mortality experienced by a group of persons of average age x is determined by two factors, (1) the age x , (2) the mortality rate experience y years before by the group, then of mean age $x - y$, of which the group aged x are the survivors. A very simple expression of such an idea would be to suppose that the rate of mortality at

* *The Lancet*, 1934 (i), p. 698, and *Journ. of Hygiene*, xxxiv, 1935, p. 433.

age x was the product of two factors, one a function of age only, the other a function of the year of birth. For imagine that in some ideal or steady state rates of mortality at ages were unchanging, at, say age 5-15, the rate was A , at age 15-25, B , 25-35, C , and so on. Then if we fill up a rectangular frame, secular time (in decennia) being the abscissa and life time (in decennia) the ordinate, the successive rows will be A 's, B 's, C 's, etc., the diagonals A , B , C , etc. Now suppose that at some point of secular time an A is changed into a times A . The diagonal of which it is the beginning will become aA , aB , aC , etc. If the next A in secular order is a' times A , its diagonal will be $a'A$, $a'B$, $a'C$, etc. If then the entries in each row are divided by A , B , C , etc., the diagonals of the figure will be first 1, 1, 1, etc., then a , a , a , etc., then a' , a' , a' , etc.

Our authors analysed the data of England and Wales, Scotland and Sweden in the light of this principle, and, apart from some discrepancies in the Swedish experience, found sufficient congruence between the observed and expected results to lead them to conclude that the method would satisfactorily extrapolate rates of mortality. To those who, like myself, admire simplicity and clearness, this work of Kermack, McKendrick and McKinlay is enormously attractive. The necessary calculations are simple, and the advantage from the point of view of *short* forecasting is, if the method be correct, great. Thus, suppose we wish to forecast the rates of mortality which will be current 50 years hence, in 1986. If the authors' simple generation method is right, we shall be able to make a wholly adequate forecast of rates of mortality at ages 60 and over, because the relevant information, viz. rates of mortality at ages 5-15, is in our possession. At ages centred on 50 we shall not do badly, because, whatever the unknown secular change in the fundamental rate, viz. mortality at 5-15, a single extrapolate of that series will not be likely to be far astray. At early ages the extrapolation will, of course, be increasingly precarious. Had we used the period method in row form, i.e. tried to determine the law of secular change for each age-group independently, then if we extrapolated on a quinquennial basis, we should need to extrapolate 10 terms of a series of which we knew only 19 members, a rash undertaking.

A similar objection can be made to the more elaborate columnar method of period graduation. Of course, if we wish to make long shots, to determine mortality a century or more ahead, Kermack, McKendrick and McKinlay's method will involve a serious extrapolation of a secular series, viz. the 5-15 row. But even then it will be far simpler than the pure secular method, for only *one* row needs consideration.

TABLE VII.
Males. England and Wales.
“Observed” and “Expected” Deaths in certain Years.

Year.	Age Group.																75-85.
	5-15.		15-25.		25-35.		35-45.		45-55.		55-65.		65-75.		Obs.	Exp.	
	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.					
1925	7,028	7,028	10,364	10,364	10,494	10,225	15,872	15,872	26,058	26,283	37,483	37,175	47,223	47,063	32,907	33,748	
1915	10,573	10,573	(11,096)	(7,926)	(13,978)	(9,892)	19,253	17,910	26,692	25,403	35,223	35,102	41,662	43,040	28,097	29,973	
1905	9,440	10,139	11,530	11,530	14,824	15,354	19,510	20,146	24,871	25,332	31,501	31,897	34,741	37,207	24,036	26,287	
1895	11,411	11,746	12,975	13,263	15,453	15,453	20,232	20,880	24,311	23,670	29,102	28,352	32,415	32,415	22,697	23,085	
1885	13,178	13,805	12,733	14,006	15,251	15,838	18,780	19,083	21,583	21,583	25,898	25,749	29,426	28,967	20,267	19,976	
1875	14,410	14,410	14,135	14,356	15,862	15,350	18,277	17,615	20,060	19,661	23,787	23,173	25,968	25,148	18,977	17,844	
1865	15,374	14,894	14,263	13,877	14,779	16,013	16,013	17,450	17,540	19,945	19,945	22,117	21,853	16,685	16,073		
1855	14,228	14,652	13,599	13,424	13,023	13,159	13,426	14,286	14,260	14,973	16,171	17,008	18,621	18,907	14,871	14,547	
1845	13,852	14,045	13,172	12,378	12,340	11,966	12,111	12,373	12,373	12,577	14,806	14,314	16,576	16,454	13,569	13,596	
χ^2	= 116.8		189.5		91.4		208.5		138.6		92.7		250.4		444.4		

TABLE IX.
Females. Death Rates per Million. England and Wales.

Age Group.	1851-60.		1861-70.		1871-80.		1881-90.		1891-1900.		1901-10.		1911-20.	
	Obs.	By Generations.	Obs.	By Generations.	Obs.	By Generations.	Obs.	By Generations.	Obs.	By Generations.	Obs.	By Generations.	Obs.	By Generations.
5-15	0,737	6,615	0,151	5,825	4,973	4,836	1,181	3,939	3,468	3,493	2,889	3,156	2,963	—
16-25	7,968	7,166	7,708	6,843	8,032	8,083	4,981	5,009	1,063	4,073	3,196	3,538	3,540	3,293
26-35	0,925	3,379	0,721	9,313	8,012	8,553	7,375	7,327	6,082	6,238	1,714	5,081	4,782	4,414
36-45	12,117	11,952	12,066	12,080	11,628	11,696	10,384	10,716	9,393	9,163	7,329	7,831	6,423	6,381
46-55	16,108	15,965	16,047	16,366	15,628	15,696	13,009	15,652	11,741	11,340	12,808	12,650	10,900	10,181
56-65	37,007	37,661	37,047	37,713	38,671	38,745	28,467	28,931	28,438	28,137	24,818	25,770	21,306	22,733
66-75	58,050	—	59,120	57,713	61,020	58,721	60,113	59,931	60,723	60,320	58,928	58,611	49,611	53,730
Mean % error	3-13		3-08		1-85		2-22		1-11		0-38		5-65	
TUBERCULOSIS. ALL FORMS.														
5-15	1,398	1,581	1,120	1,353	965	976	952	808	781	686	701	687	683	—
16-25	4,081	4,181	3,077	3,107	2,015	2,717	2,371	2,110	1,672	1,772	1,338	1,603	1,471	1,507
26-35	4,690	4,755	4,182	4,256	3,323	3,353	2,032	2,794	2,086	2,176	1,651	1,802	1,481	1,529
36-45	1,293	4,410	3,173	3,843	3,671	3,198	2,816	2,519	2,291	2,237	1,710	1,769	1,401	1,456
46-55	2,236	3,317	2,654	2,849	2,132	2,182	2,116	2,321	1,753	1,840	1,119	1,188	1,136	1,136
56-65	2,523	2,116	1,866	2,178	1,845	1,845	1,597	1,608	1,514	1,139	1,186	1,192	913	913
66-75	1,783	—	1,354	1,417	1,193	1,233	1,058	1,052	900	943	831	813	730	699
Mean % error	4-06		5-48		2-49		1-61		5-55		4-80		3-03	
BRONCHITIS.														
5-15	—	—	112	132	122	101	116	76	71	55	37	43	38	—
16-25	—	—	85	88	77	61	59	49	39	37	20	27	21	21
26-35	—	—	217	222	213	182	164	133	105	102	48	77	54	56
36-45	—	—	650	624	651	551	504	362	362	362	182	253	131	191
46-55	—	—	1,460	1,621	1,639	1,509	1,412	1,332	1,139	1,089	621	799	521	612
56-65	—	—	1,058	1,138	1,767	4,323	4,163	4,021	3,454	3,552	2,291	2,903	1,824	2,131
66-75	—	—	9,573	—	11,960	10,971	10,603	10,638	9,923	9,903	7,022	8,710	6,472	7,145
Mean % error	—		9-67		12-25		12-85		6-64		32-90		14-16	

For the purpose of comparing the success of this simple method applied to English data with that of Cramér and Wold used on Swedish data, I compared observed and expected deaths for males and females for calendar years separated by a decennium. For the purposes of this comparison the actual recorded deaths in age-groups were not used, but the numbers obtained by multiplying the death-rate by the mean population of the age-group for the decennium or, in the case of 1925, by the estimate for the year. Since Kermack, McKendrick and McKinlay reached the death-rates at 5-15 and 15-25 by simple averaging of the constituent quinquennial rates, this seemed a fairer method, although it will not, of course, reproduce exactly the actual deaths. One merely requires an idea of the order of magnitude of the deviations.

χ^2 ranges for each set from 111.7 to 800.6 for females, and from 91.4 to 444.4 for males. No doubt a more refined method of fitting might lead to a reduction of χ^2 , but, as in Cramér and Wold's case, it is not probable—and is not reasonably to be expected—that the divergencies between observation and expectation are mere chance fluctuations. When the percentage deviations of calculated and recorded rates are compared, it is found that the approximations are at least as close as those of Cramér and Wold. In Table IX are shown applications of the method to a different range of data.*

These were chosen because I rather expected (*vide infra*) that the method would fit the data of mortality from tuberculosis better than those of all causes, I expected that it would not fit deaths from violence at all, and chose valvular disease of the heart and nephritis as examples of diseases the *recorded* mortality from which has increased. My expectation that the death-rates from violence would be refractory is fulfilled; the tuberculosis rates, on the other hand, are *less* well reproduced than the all causes rates. The rates from valvular disease of the heart are very well reproduced, those from nephritis very badly. The question now arises as to whether a period method would be equally successful. I have not faced the labour of trying a columnar method. A row method is open to two objections, the first that unless some process of welding is used, it is not a two-dimensional method; the second that crude methods, such as the fitting of straight lines to the whole of the observed rates or to their logarithms, are plainly irrational. Before we begin the work we know it will not succeed. A less preposterous row method would be to fit logistic functions, because it is not absurd to suppose that in secular time a death-rate will

* For this work I am indebted to my colleague, Mr. W. J. Martin, B.Sc., who has made or verified all the calculations.

move from an upper to a lower asymptote. If one takes the simplest and most easily fitted logistic, viz. one with a lower asymptote of zero, the results tested in precisely the same way as those of the generation method were clearly inferior to those of the latter. Many of the rates on males could not be graduated by a simple method of fitting, while for females the fits at ages centred on 10, 20 and 70 were worse and those centred on 40, 50 and 80 about the same as for the generation method. The age group 25-30 was better fitted by a logistic ($\chi^2 = 465.6$) 55-65 was refractory.

But I am not satisfied that a more general logistic would give inferior arithmetical results to those of the generation method. Indeed, the following experiments suggest that we must not put too much weight on the arithmetical success of the generation method. Suppose we write the equation of the logistic in the form: $-y = \frac{A + Be^{kt}}{1 + e^{kt}}$, where the origin of t is the point of inflection. An efficient method of fitting *ab initio*, which involves determining the two asymptotes, the position in secular time of the point of inflection and the constant k , is a laborious affair. But it is, of

TABLE X.
Females. 45-55.

Quinquennium.	Rate.	Generation Values.	Logistic 1.	Logistic 2.
1841-45	15.1	16.2	15.7	15.5
1846-50	17.0	16.1	15.7	15.5
1851-55	15.8	16.1	15.7	15.5
1856-60	14.8	16.2	15.6	15.5
1861-65	15.5	16.3	15.6	15.5
1866-70	15.8	16.2	15.6	15.5
1871-75	15.9	16.0	15.5	15.5
1876-80	15.3	15.7	15.5	15.5
1881-85	15.2	15.3	15.3	15.4
1896-90	15.0	14.8	15.2	15.3
1891-95	15.2	14.2	14.9	15.1
1896-1900	14.3	13.5	14.4	14.7
1901-05	13.1	12.6	13.9	14.0
1906-10	12.0	11.7	13.1	12.9
1911-15	11.4	10.6	12.0	11.5
1916-20	10.4	9.5	10.6	10.1
1921-25	8.8	8.5	9.0	9.0
1926-30	8.4	7.5	7.2	8.3
Mean Deviation as Percentage of Mean ...	—	4.50	3.41	2.89

$$\text{Logistic 1 from data } y = \frac{15.676}{1 + e^{\frac{.346 + t}{2.265}}}, \text{ origin 1926-30, unit of } t, 5 \text{ years.}$$

$$\text{Logistic 2 } y = \frac{7.5 + 15.5e^{-0.15t}}{1 + e^{-0.15t}}, \text{ origin of } t \text{ 1911-15, unit of } t, 1 \text{ year.}$$

TABLE XI.
Females. 55-65.

Quinquennium.	Rate.	Generation Value.	Logistic.
1841-45	27.2	29.0	28.5
1846-50	29.7	28.7	28.5
1851-55	27.8	28.5	28.5
1856-60	26.5	28.5	28.5
1861-65	27.9	28.5	28.5
1866-70	27.9	28.6	28.5
1871-75	28.7	28.7	28.5
1876-80	28.6	28.6	28.4
1881-85	28.1	28.3	28.4
1886-90	28.8	27.7	28.2
1891-95	29.5	27.1	27.9
1896-1900	27.4	26.2	27.4
1901-05	25.4	25.2	26.3
1906-10	24.3	23.8	24.7
1911-15	22.7	22.3	22.5
1916-20	20.4	20.6	20.3
1921-25	18.6	18.7	18.7
1926-30	17.7	16.8	17.6
Mean Deviation as Per- centage of Mean ...	—	3.00	2.38

$$\text{Logistic } y = \frac{16.5 + 28.5e^{-0.15x}}{1 + e^{-0.15x}} \text{ origin 1911-15.}$$

TABLE XII.
Females. 65-75.

Quinquennium.	Rate.	Generation Value.	Logistic.
1841-45	59.1	61.7	61.0
1846-50	62.7	61.2	61.0
1851-55	59.7	60.5	61.0
1856-60	58.1	60.0	61.0
1861-65	59.1	59.6	61.0
1866-70	59.1	59.5	61.0
1871-75	61.3	59.5	61.0
1876-80	60.8	59.7	60.9
1881-85	59.1	60.0	60.8
1886-90	61.7	59.8	60.6
1891-95	63.0	59.0	60.2
1896-1900	58.5	57.9	59.4
1901-05	54.8	56.5	57.9
1906-10	53.1	54.7	55.5
1911-15	51.7	52.5	52.5
1916-20	47.7	49.8	49.5
1921-25	46.0	46.6	47.1
1926-30	46.0	43.0	45.6
Mean Deviation as Per- centage of Mean ...	—	2.72	2.76

$$\text{Logistic } y = \frac{44 + 61e^{-0.15x}}{1 + e^{-0.15x}} \text{ origin 1911-15.}$$

course, easy enough to *guess* values and see what happens. If one guesses A and B , then places the point of inflection near any value in the secular series which has a rate of mortality not far from $(A + B)/2$, it is easy, with the help of a table of the exponential function, to find reasonable values for k . I set myself this problem. Taking the rates of mortality at ages 45-55, 55-65 and 65-75 (which looked unpromising from the logistic point of view), could one, by brute guessing, reach graduations as good as those of the generation method? Since this does not pretend to be anything but a sporting trial, I merely compared the deviations of "observed" from "calculated" (without regard to sign). The results were these. For females "guessed" logistics, with the point of inflection in 1911-15, gave better fits at ages 45-55 and 55-65 than the generation method, and almost the same fit at 65-75. For males the guessed logistic is slightly better at 65-75, a little worse at 45-55 and much worse at 55-65. But as the run of the figures at 55-65 was preposterously unlike a simple logistic, I split it into two parts, and then obtained a graduation little different from that of the generation method.

TABLE XIII.

Males aged 45-55 years.

Quinquennium.	Rate.	Generation Value.	Guessed Logistic.*
1841-45	17.2	18.5	19.0
1846-50	19.2	18.6	19.0
1851-55	18.6	18.8	19.0
1856-60	17.5	19.0	19.0
1861-65	18.9	19.3	19.0
1866-70	19.6	19.5	19.0
1871-75	20.3	19.6	19.0
1876-80	19.8	19.6	19.0
1881-85	19.3	19.5	18.9
1886-90	19.4	19.1	18.8
1891-95	19.5	18.6	18.6
1896-1900	18.4	17.8	18.2
1901-05	17.0	16.9	17.5
1906-10	15.5	15.7	16.4
1911-15	14.9	14.4	15.0
1916-20	14.0	13.2	13.6
1921-25	11.6	12.1	12.5
1926-30	11.7	11.0	11.8
Mean Deviation as Percentage of Mean ...	—	3.14	3.75

$$* y = \frac{11 + 19e^{-0.15t}}{1 + e^{-0.15t}} \text{ origin of } t \text{ 1911-15.}$$

I confess that these results rather shake me as an arithmetician. I am not so sure as I was that a less happy-go-lucky application of

the logistic form would not *graduate* the rates of mortality better than Kermack, McKendrick and McKinlay's method. Perhaps some young mathematical statistician will try. If he succeeded, would it be fair to say that the authors' biological hypothesis needs no further consideration? I think not. In the first place, I do not feel inclined to attach any biological importance to the arithmetical values obtained by the logistics. I have not the least confidence that the mortality rate of women aged 45-55 will never be less than 7.5 per 1000, or that of women aged 55-65 never less than 16.5 per 1000. It is sufficient to note that a logistic fitted on the assumption that the lower asymptote of mortality at 45-55 is *zero* graduates the data almost as well as the logistic asymptoting to 7.5.

TABLE XIV.
Males aged 55-65 years.

Quinquennium.	Rate.	Generation Value.	Guessed Logistic.*
1841-45	30.3	32.6	30.0
1846-50	33.2	32.5	30.0
1851-55	31.6	32.5	30.1
1856-60	30.4	32.7	30.2
1861-65	32.8	33.0	30.5
1866-70	33.5	33.4	31.1
1871-75	34.8	33.8	32.3
1876-80	34.9	34.2	33.7
1881-85	34.2	34.4	34.9
1886-90	35.2	34.3	35.5
1891-95	35.8	34.1	35.8
1896-1900... ..	34.1	33.5	33.4
1901-05	32.4	32.5	32.9
1906-10	31.2	31.2	31.8
1911-15	30.2	29.5	30.2
1916-20	27.9	27.5	28.0
1921-25	24.8	25.2	25.8
1926-30	24.0	23.1	24.2
Mean Deviation as Percentage of Mean ...	—	2.47	3.10

* Logistic value for 1841-45 to 1891-95 deduced from

$$y = \frac{30 + 36e^{1.0.2t}}{1 + e^{1.0.2t}}$$

where origin of t is halfway between 1871-75 and 1876-80. Values for 1896-1900 deduced from

$$y = \frac{22 + 34e^{-0.15t}}{1 + e^{-0.15t}}$$

where origin of t is 1916-20.

The whole subject of critically evaluating the effectiveness of postulated "laws" of mortality needs the attention of a mathematical statistician of greater ability and knowledge than I. My

TABLE XV.
Males aged 65-75 years.

Quinquennium.	Rate.	Generation Value.	Guessed Logistic.*
1841-45	65.5	67.5	70.0
1846-50	69.5	66.9	70.0
1851-55	66.7	66.4	70.0
1856-60	64.3	66.3	70.0
1861-65	66.4	66.3	70.0
1866-70	67.8	66.7	70.0
1871-75	70.1	67.3	70.0
1876-80	69.4	68.1	69.9
1881-85	68.8	69.0	69.8
1886-90	72.1	69.7	69.6
1891-95	72.5	70.2	69.2
1896-1900... ..	68.3	70.1	68.4
1900-05	65.3	69.6	67.1
1906-10	64.4	68.3	65.1
1911-15	64.1	66.4	62.9
1916-20	63.0	63.6	60.9
1921-25	58.6	60.3	59.6
1926-30	59.7	56.1	58.8
Mean Deviation as Percentage of Mean ...	—	2.95	2.93

$$* y = \frac{58 + 70e^{-0.15t}}{1 + e^{-0.15t}}.$$

The origin of t is midway between 1906-10 and 1911-15.

present opinion is that the arithmetical success of this form of the generation method is not sufficient to enforce assent to the biological and hygienic conclusions drawn by its advocates, but amply sufficient to justify the most careful attention to their arguments. To these I now turn. The authors, of course, refer to the possibility that the lag in the improvement of mortality in later age-groups might be due to a lag in the introduction of environmental reforms calculated to influence mortality at later ages—for instance, factory legislation, at first directed solely to the protection of children. But they think it would be “somewhat surprising if the quantitative regularity just pointed out should emerge.” “It would seem,” they write, “that the actual calendar year is of relatively little importance in determining the improvement in the specific death-rates. What is of importance is the year of birth of the generation or group of individuals under consideration. Each generation after the age of five years seems to carry along with it the same relative mortality throughout adult life, and even into extreme old age.”

I have already pointed out that there is evidence that social legislation and, what is perhaps more important, the trend of public feeling did move from the amelioration of child life to the protection

of women, and only later to the safeguarding of the conditions of life of adult males. I have also called attention to Farr's explanation of the facts. Reference to more strictly medical literature also suggests an increasing interest as time passed in the general rather than the specific factors of healthy living. In 1867 Sir George Buchanan, the distinguished father of a distinguished son, published in the Ninth Report of the Medical Officer of the Privy Council (pp. 40-209) the first critical study of the probable effects of sanitary legislation. His plan was to study in detail changes in the mortality of 25 towns wherein sanitary improvements, drainage, water supply, paving, etc., had been effected. The medical statistics of the towns before improvement—usually about the epoch of 1850—were compared with the most recent figures. In general, the results seemed satisfactory, and "The progress made by the inhabitants of most of the 25 towns in decency, cleanliness, self-respect and morality, was, at the least, as striking as the improvement in their health measured by the mortality returns." I do not propose to examine the detailed results, but the points to be noted are: (1) that the improvements, although often *prima facie* considerable, were not uniform, and (2) the preparation and publication of such a report marked a more critical and investigatory spirit in the sanitary service; it was an early indication of the now universal opinion that drains, water and housing (on a narrow scale) might not be the only matters needing attention. One apparent conclusion, viz. a connection between the wetness of the soil and mortality from phthisis, led to further investigation, the results of which were communicated in a report by the same author in the following year (Tenth Report, pp. 57-110). It would be right to say that in the second half of Queen Victoria's reign attention was beginning to be directed to the more general factors of mortality, and that consequently the ætiology of diseases attacking the years of life beyond childhood and not due, or not believed to be due, to contamination of food or drink, began to receive sanitary attention. It is therefore probable that a time lag in the amelioration of conditions affecting later ages directly *has* played some part in producing the diagonal regularity which is the basis of Kermack, McKendrick and McKinlay's conclusion.

Perhaps I should add that while the secular regularity of these successions is plainly far from exact, some may think that the arithmetical regularity to be explained is also not perfect. Considerations of this kind are, I think, more important than more obvious criticisms. Thus it will be said that there are *many* causes of death operating at later ages the effect of which cannot be influenced one way or the other by what happened to the exposed to

risk many years before. When we leave this meeting our risks of dying violent deaths before we reach our homes are greater than those of our predecessors meeting in St. James's Square, and hardly differentiated by what happened to us between the ages of 5 and 15. Our risks of dying of typhoid fever this vacation will be influenced much more by where we spend the vacation than by where we were taken for our holidays by our parents. And so one could run through a long catalogue of named causes of death. But, obvious as all this is, it is not statistically important. These short-term bills of mortality are not relatively important items in the whole mortuary charge. As an experiment I selected from the titles used in Farr's classical Supplement to the 35th Annual Report those which seemed to belong to the class.* They accounted in all for a mortality rate of 21.5 per 10,000 males aged 45-55 in 1848-72 out of a total mortality of 185.9. In 1929-33 the equivalent names accounted for 4.8 per 10,000 out of 115.8. It is true that these causes have proportionately declined more than others, which is, for what it is worth, an argument against our authors' view; but it is not, numerically, worth much. What are the *large* items of middle-age mortality? Take the latest available year, 1934, and the case of persons aged 45-65, of persons well past their physical prime in the opinion of all, and well past their intellectual prime in the opinion of all under the age of 45, but in practically undisputed possession of all the best-paid and most responsible posts in this country—excepting those occupied by persons over 65. Of males, 68,733 died and of females 55,239 died in this age group. All forms of cancer account for 12,523 deaths of males and 14,384 deaths of females. Diseases of the Respiratory System account for 8,036 deaths of males and 3,781 deaths of females. These two items account for practically one-third (29.9 per cent. and 32.9 per cent.) of the whole mortality; Heart Diseases, Cerebral Hæmorrhage and Apoplexy account for 26.2 per cent. and 28.4 per cent., so we have more than half the total covered. Influenza, a short-term liability, accounts for only 1.6 per cent. and 1.4 per cent., and Tuberculosis, a disease which *par excellence* belongs to the group amenable to early environment, accounts for 8.3 per cent. and 4.1 per cent. There is nothing intrinsically absurd in holding that the respective forces of the major mortalities are determined by the stamina vitæ woven in childhood. It is not a comfortable doctrine to those of us who belong to the age group 45-65; but that does not prove it

* Measles, Scarlet Fever, Diphtheria, Quinsy, Croup, Whooping Cough, Typhus, Carbuncle, Dysentery, Diarrhœa, Cholera, Remittent Fever, Syphilis, Hydrophobia, Glanders, Privation, Alcoholism, Aneurism, Enteritis, Peritonitis, Ileus, Fistula, Homicide, Execution. The propriety of the choice will naturally not be admitted in every case by everybody.

to be untrue. I should not, however, abandon hope that directly operative environmental factors influence the mortality rate from diseases of the respiratory system. Geographical and occupational contrasts, the sexual differentiation, even the clinical fact that alcoholic intemperance (a vice rarely begun in early youth) greatly worsens the prognosis of pneumonia, all point to the probability that factors coming into play after childhood are important. Similar considerations apply to the problem of malignant disease. To the statistical student of disease cancer is not a hopeful object of study, but a perusal of clinical records and of the last report of the Director of the Imperial Cancer Research Fund gives some ground for optimism.

All these considerations lead me to wish—true to the traditions of the civil service—to insert in Kermack, McKendrick and McKinlay's dictum—"Each generation after the age of five years seems to carry along with it the same relative mortality throughout adult life"—perhaps, 'it is possible that,' 'it might be argued that' or some other of our beloved impersonal qualifications.

I do not think persons over the age of 40 need abandon hope that social and hygienic betterments introduced after their school-days may increase their expectations of life. But that does not affect the main contention, that what happens in the earlier years is of more importance. It is, of course, not a novelty; *maxima debetur puero reverentia* is a rule long since given a wider application than its author's. At the present time the needs of children and adolescents, both bodily and spiritual, occupy the first place in official programmes of reform. It is not yet eighteen years since a holocaust of youth greater than any other in the history of the world was ended. It seems to many that another is in preparation. There is, perhaps, this grain of statistical comfort in the pictured horrors of our prophets, viz. that the coming slaughter will be more indiscriminate, less confined to the young and physically fit. The immunity of those whose wickedness and folly lead to war may be less complete, the *proportion* of survivors physically and mentally fit to rebuild the world may be greater. Even if the worst happens, such contributions as we can make to improving the conditions of life for the young will not be wasted labour. And the worst may not happen; the very realization of the dangers amid which we live may be a defence. But speculative as has been the whole of this address, these final speculations exceed even the licence I have given myself, and I will draw towards a conclusion. My history of our declining death-rate has been fragmentary, it falls greatly short of Dr. Snow's desires. But I think it gives ground for optimism. We have seen that improvement has exceeded the expectations of

the most optimistic of our grandparents. We have seen ground for believing that a principal factor is the environment of early life, and there is ample evidence that the importance of this factor is generally realized. In this Society we have contributed to public enlightenment on many social problems intimately concerning the welfare of the young, and have never been more active than now in encouraging researches of this kind. *Maxima debetur puero reverentia* has informed many investigations submitted to us. I leave this chair with every confidence that a not distant successor will be able to give a not less optimistic but much less speculative account of further improvements and how they were effected. One of our greatest writers said this:—

“I have told you candidly my sentiments. I think they are not likely to alter yours. I do not know that they ought. You are young; you cannot guide, but must follow the fortune of your country. But hereafter they may be of some use to you, in some future form which your commonwealth may take. In the present it can hardly remain; but before its final settlement it may be obliged to pass, as one of our poets says, ‘through great varieties of untried being’ and in all its transmigrations to be purified by fire and blood.” Like all Burke’s reflections, these can be generalized, and our younger fellows may lay them to heart. Purification by blood and fire is, we may hope, a too-energetic metaphor for the transmigrations of our ideas, or even of our rates of mortality. But that there will indeed be transmigrations is sure, and the younger we are the more we are influenced by a reigning fashion of interpretation. At present we are, I think, rather prone to over-emphasize any factor which happens to be a subject of general discussion. At one moment, perhaps, domestic housing, at another national nutrition, attracts almost universal attention. It is the duty of the young statistician not to be a prig and sneer at generous enthusiasms, but to keep a cool head, and always to seek measures of the importance of the several factors. Perhaps that will be easier if he can share the emotional belief I hope I shall never grow old enough to lose, that no honest attempts to make the lives of human beings more agreeable are made in vain, and that apparent failure often leads to ultimate triumph.

“For while the tired waves, vainly breaking,
Seem here no painful inch to gain,
Far back, through creeks and inlets making,
Comes silent, flooding in, the main.

And not by eastern windows only,
When daylight comes, comes in the light;
In front, the sun climbs slow, how slowly,
But westward, look, the land is bright.”

PROCEEDINGS OF THE MEETING.

MR. UDNY YULE: I am glad to propose the vote of thanks to Professor Greenwood for his most interesting address, but I am sure that the President whom we have just welcomed to the Chair will understandingly forgive me for saying that as all partings are rather sad, our pleasure is greatly qualified by the fact that it is a valedictory address; it hardly seems possible that two years can have separated our *ave* and our *vale* to the late President.

Apart altogether from its details, the course of the English death rate, with which Professor Greenwood has dealt in the first part of his address, always seems to me one of the most astonishing pictures presented by our statistics. Since the late 'sixties of the last century, the general level of mortality, as measured by the standardized death rate, has been halved, and, if we bring in the data for the very latest years, a little more than halved. At the younger age-groups, up to middle life, the fall has been even more striking, as Professor Greenwood has pointed out. As a matter of fact, if we take the rates for 1866-70 as 100, the corresponding figures at successive ages for 1926-30 are:

	Males.	Females.
0-	32	29
5-	32	31
10-	37	35
15-	43	38
20-	39	38
25-	37	34
35-	45	39

Now I, as it happens, was born in 1871, which may not unfairly be taken as the year in which the fall began, so that the story of this whole fall is just the story of English mortality during my own lifetime. Even when I first began to take an interest in statistics, say in the quinquennium 1891-95, I do not think anybody ever dreamed that death rates could fall as low as they have in fact fallen. That such a change must mean a very great improvement in the condition of the poorer part of our population, which forms the great majority of it, seems to me obvious, and I think this cheering story deserves some special emphasis at present, when there is much talk, some of it sensible, but some of it a bit lurid, and some of it—I think it is hardly too much to say—a little hysterical, on such matters as housing, unemployment and nutrition. Some of it indeed is to me almost incredible, for if any large proportion of our population be as seriously under-nourished as is sometimes represented, the existence of such low death rates becomes difficult to explain, and if unemployment were as grave a factor as is sometimes alleged, it would be odd that unexampled unemployment should be accompanied by record low mortalities. I wish that our President had been much rasher than he has been, and had said more to lighten our darkness on these very controversial questions.

With his thesis that the factors which have contributed to the fall cannot be wholly included under the head of hygiene—unless that

term be given an unusually wide connotation—I find myself in hearty agreement, as with the view that these factors are hardly susceptible of anything like exact numerical measurement. I hope you will rejoice with me that the President on p. 685 could not resist the temptation to say that to make life more livable seemed quite as worthy a motive as to make it longer—a noteworthy and very characteristic *obiter dictum* which I think is worth dwelling on for a moment. Does he wish us to draw the conclusion that, diverse as may be the consequences of the two motives in many respects, yet in one they may be the same? That if life has been made more livable, as one natural consequence it may perhaps be more lived, quantitatively as well as qualitatively; that perhaps goodness, truth and beauty, as well as soap and sewers, food for the mind as well as food for the body, may have some favourable influence upon our mortality, in more senses than one of that term. I think perhaps he did intend us so to extend the conclusion and so associate the matter of this address with the unforbidden thoughts of the last in the second part on the function of a University.

Let me too accept his invitation to indulge in reveries on the past. We first came to live in London when I was only some four years old, and first went to a house in London somewhere in Balham or Tooting or that neighbourhood. There one of my earliest recollections is concerned with hygiene in the narrower sense. Twice during the one year we were there, high tides or perhaps heavy rains backed the water of the sewers, and we had several feet of sewage flooding our basement. I can definitely remember being taken a few steps down the kitchen stairs and seeing chairs floating in and beetles on that filthy flood.

We then went to live in Bayswater. To think of those days seems to take me into almost a different world. The mostly macadamized streets were thick with mud in wet weather, and every profitable crossing had its crossing-sweeper. Where are the crossing-sweepers now, and where the corresponding number of beggars? Crossing-sweepers and beggars were naturally clothed raggedly and filthily, but it seems to me, at least in memory, that one might almost have said the same of the working classes in those days. Travelling on the Underground about the time that men came from their work, in the dirty jackets and corduroys in which they had been working, was anything but pleasant. The cigarette was then no smoke for the working man; he smoked a short clay pipe. With a short clay pipe spitting is inevitable, and the floors of the Underground railway carriages were almost slippery with saliva. In the evenings there were then practically no counter attractions to the public house; the sight of drunken men and women, a free fight, or even of a man lying in the gutter, does not seem to have been very rare.

As regards another matter—vermin—I think the improvement has been almost as striking. Giving unintended hospitality to a hungry flea picked up in some growler or hansom cab, or on the Underground Railway, was not exceedingly rare. Keating's Powder was an invaluable item in the outfit for the summer holidays, and I have dreadful recollections of our taking a house at the sea-

side—according to my recollection it was a doctor's house—out of which we fled the next morning, hopelessly routed by its hoards of saltatory inhabitants. In spite of their respective dates, my memories of these early years always seem to call up pictures much more reminiscent of Mayhew's *London Labour and the London Poor* rather than the later work of Charles Booth.

In the second part of his address, the President has dealt with a very difficult problem with his usual caution and perspicuity. Interpolation is a great game, especially if you have extrapolation in view, but it is necessary to remember that, according to Lewis and Short, *interpolare* can not only mean to give a new form to something, to *polish up*, but also to *corrupt*, to *falsify*. That is why the caution, so well exhibited by the President, is very necessary. The point that interests me by far the most in that discussion—and I think interests the President most—is the question raised by the investigations of Kermack, McKendrick and McKinlay as to the relative influences on the mortality of any age-group of (a) the conditions to which it had been earlier subjected, especially at the beginning of life and of (b) the contemporaneous conditions. On that question I hope the President's address will lead to further investigations; it seems to me a most interesting point.

Let me conclude, then, by formally moving a Vote of Thanks, and as the Council and Officers were included in the motion moved at the end of the Annual General Meeting, let me add to that vote of thanks an expression of our thanks for all the President himself has done for the Society during his term of office, and of our best wishes for his future welfare.

SIR JOSIAH STAMP: A line of ex-Presidents of a Society like this has often been likened to a row of extinct volcanoes; they are, however, all allowed from time to time to have a short period of return to action, notably when another volcano is joining their ranks. But we do know that on this occasion the volcano that is going into the category of the extinct will not remain so; he has given sufficient evidence in this address of an activity of which we shall hope to have the benefit in years to come. He talks about the age-group into which he falls as though this were almost a valedictory address, but we know that intellectually there lie beyond it vast fields of possibility.

Before referring to his address in detail, I should like to say how delighted I was that this particular paper was before us when our new President came in. I do not suppose we shall have anything during our new President's period of office that will be outside his intellectual range and life's experience, but as one whom we knew mainly as a great Minister of Health not long ago, to-day must have convinced him that he had really come into the right meeting; on some occasions he might not have been so certain, but this subject must have been so familiar to him that a more suitable welcome could not have been provided, or an occasion on which he would feel more at home.

It is a tradition in this Society, as in other learned Societies,

that a Presidential address is not criticized; it is discreetly praised. I am very glad that is the case, not so much for the author's sake as for my own, because an attempt to criticize it adequately would certainly expose the range of my own ineptitude and ignorance. We have had one more of Professor Greenwood's princely contributions on a subject of which he is a master. and with it all those qualities that we associate with him, that humanist and cultured background for all his fine technical material. He disclaims learning, innocently but quite ineffectively: there are sometimes certain portions of an address of his where we may not wholly enter into and enjoy the technique; but then we can fully savour and value the setting or the background—rather like listening to an opera in a language not understood, where one can still enjoy the richness of the scenery, and the beauty, harmony, and rhythm of the music and the action. And so, although we may not be able to follow the particular technique he has adopted, we may see in that illustrative Table IV how his mind works, and enjoy the play. He has given us the qualities that we have learned to expect from him, a lambent and revealing humour and sometimes a very sardonic comment that quite inadequately conceals a quality of outlook on life that moves and wins us all. His scientific method is shot through with artistic and emotional perception—a very rare combination—and we are lucky indeed in this Society to have had those qualities with us in so large a measure during this period.

I may now refer to Dr. Snow's paper of eighteen months ago. A great paper can have two qualities—what it actually gives us, and what it gives rise to. We understand that this Presidential address is the hatching out of the egg then laid. Dr. Snow set before the President a task, and we are deeply indebted to him for so doing; but I have a personal point on it because a certain undertaking was given which still remains undischarged. In dealing with Dr. Snow's paper I referred to the question of cause and effect, and to the interest there would be in examining the effect of social improvements on the death rate, and especially of increasing *per capita* the food consumption. I pointed out that if there was a rise in standard of life of 100 per cent. in that period, inasmuch as it did not come evenly, at some periods it must have been very striking, and would show most in *per capita* food consumption, which might have more to do with mortality rates than even hygienic and public health considerations. I suggested that the vital statistics might be examined again in the light of these improvements. Dr. Snow dealt with that in his final reply by postponing it and giving a promissory note for to-day, forging the signature of our President. Our President has dealt with it to this extent, that he has put first the "standard of life" considerations, and secondly the "preventive" considerations.

It is quite clear that however great might be the improvements in public health generally, such hygienic considerations must have had a much greater chance of success if they were working on a favourable phase, by the defensive mechanism set up in the human being through greater nutritional advantages in early life. If

Dr. Snow will present Professor Greenwood with a table of figures of the *per capita* increase in consumption of food, in each quinquennium available, for the first two age-groups, and also another table of the *per capita* expenditure in public health improvements, there will be two causative lines, and Professor Greenwood will then be able to perform wonders of multiple correlations upon them with the death rates of some twenty years later, and will perhaps give a quantitative statement of what he thinks should take precedence in this history of our death rates. That there were remarkable new advantages in those early ages goes without saying, and they must have had important effects on building up constitutionally those who enjoyed such increases as against the risks of mortality 20 to 30 years later.

The food imports should be capable of broad quantification, and it should be possible to do something with them in relation to the mortality figures of periods of years afterwards. It will always be difficult to disentangle the family density from the risk of death associated with it, all other things being equal. By family density, I do not mean overcrowding, but the number of births per marriage.

This question of food supplies, in its effect upon mortality, and particularly in its effect of giving much greater scope for public health improvements, seems to me to be of extraordinary importance and very little explored. How did this extraordinary increase of food supply and nutritional values come about? By very cheap wheat supplies, because many producers were living upon future capitalization of land values rather than the productivity of immediate toil. When it came to an end, the English population were not only living on that fortuitous circumstance, but also on the negative one, that they were drawing upon the deterioration of British agriculture. That subject might be pursued in various directions. It was not necessary to go backwards; one could go forwards and establish clinically what these nutritional indices might be able to do, and from that bring into play these forces that Professor Greenwood had said were of such tremendous importance in the history of mortality rates of the century.

May I join with the proposer of the vote of thanks in saying how grateful the Society is not only for the great contributions he has made in his addresses, but also for the way in which he has presided over the proceedings of the Society; his wisdom and practical knowledge, his long knowledge of the Society's affairs and the close way he has been able to attend to all the duties of Council, Executive and General meetings, are all qualities for which we give him our grateful thanks.

THE RT. HON. LORD KENNET: It has been formally moved and seconded that we give our cordial vote of thanks to our retiring President for his brilliant and most absorbing address, and I have much pleasure in putting this vote to the meeting. (*Carried unanimously.*)

PROFESSOR GREENWOOD: I thank you for the way you have

received the address, and will make use of the ritual remark, that at this advanced hour it would not be practical of me to reply at length, and it would also be a bad precedent, because it would suggest that the President, after delivering his address, would be called upon to reply if not to criticism, at any rate to praise.

I must confess that my old friend Mr. Udny Yule's incitement to say exactly what I thought about some of the critics of the Ministry of Health in connection with various hygienic problems was a serious temptation, but I must not yield to it. If I did, I might be accused, like my late official chief, now my chief in this society, of treating earnest human sympathies with contempt. It does not really follow that because one does not think that the state of the people has deteriorated in every way, that therefore one is either blind to evils, horrible evils, or unwilling to mitigate them.

Sir Josiah Stamp's suggestion that I should prepare another paper is a generous one. Perhaps my volcano is not wholly extinct, but it may be allowed a decent interval before further activity is extrapolated.

I thank you all very heartily for the kind way in which you have received this address.

As a result of the Ballot taken during the Meeting the candidates named below were elected Fellows of the Society :—

John Lancelot Brown.

James Bertram Home.

Herbert William Robinson.

Corporative representative.

Ernest Jack Lusted, A.S.S.A., representing Messrs. Peek, Frean and Company, Ltd.

MISCELLANEA.

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RECENT ADVANCES IN MATHEMATICAL STATISTICS (1934).

Edited by J. O. IRWIN, Sc.D., D.Sc.

(of the Division of Epidemiology and Vital Statistics, London School of Hygiene and Tropical Medicine).

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W. L. STEVENS, B.A.

THIS is the fifth article of the above series covering the year 1934. Several reviews of mathematical literature appearing elsewhere must be noted. The longest is P. R. Rider's in the *Journal of the American Statistical Association* (A 93) with 177 references going down to the early part of 1934. Rider refers to surveys of the literature by Shewhart and Darmon in *Econometrica*, the latter including some papers published as late as 1934.

Deming and Birge (A 38) have given a good summary, intended primarily for physicists, of modern statistical methods as applied mainly to single samples from normal populations. Due emphasis is given to the results that Helmert had already obtained before 1880.

As usual we must emphasize that we have had to use our own judgment on the selection of topics for discussion. We do not propose to review here all the papers that have appeared in the Supplement to the *Journal of the Royal Statistical Society*, but among papers that seem to us particularly worthy of study are Neyman's (A 84) on the two different aspects of the representative method, the method of stratified sampling and the method of purposive selection, and Yates' on con-

tingency tables involving small numbers and the χ^2 test (A 131). Other papers again might have been reviewed here, had Rider not already done so; among them is Schmidt's "Statistical Analysis of One Dimensional Distributions."

Finally it may be well to say that the views expressed represent only our own opinions.

We start with the contribution on the "Law of Large Numbers" promised in our last article. This includes references to a number of papers published in 1933 and earlier years.

I. *Recent Advances in Probability Theory—The Law of Large Numbers and other Investigations in Probability.**

By E. C. FIELLER, M.A.

In dealing with recent Continental work connected with the Law of Large Numbers, it is convenient to begin by recalling briefly one or two well-known results.† Consider first a series of n independent trials, the probability of success at each being p , and of failure $q = 1 - p$. The number of successes, s_n , occurring in the resulting series is a variate assuming the values

$$0, 1, \dots, r, \dots, n$$

with probabilities

$$q^n, \binom{n}{1}q^{n-1}p, \dots, \binom{n}{r}q^{n-r}p^r, \dots, p^n$$

which are the successive terms in the binomial expansion of $(q + p)^n$. The expectation of s_n is np , and its second and fourth moments about np are

$$\mu_2(s_n) = npq, \mu_4(s_n) = 3n^2p^2q^2 - 6np^2q^2 + npq \quad (1)$$

James Bernoulli (*Ars Conjectandi*, 1717) was the first to enunciate and prove what is now often referred to as the first fundamental theorem of the Calculus of Probabilities, namely, that by choosing n sufficiently large we can make it as nearly certain as we please that $\frac{1}{n}s_n$ will lie as near as we like to p . Symbolically.‡

$$(\epsilon, \eta > 0), \exists n_0, P\left\{|p - \frac{1}{n}s_n| < \epsilon\right\} > 1 - \eta, \text{ for all } n \geq n_0 \quad (2)$$

Bernoulli's work was quite satisfactory as a proof of the existence theorem, but it fell short of providing any very precise evaluation of

* The reference numbers in this section refer to section B of the bibliography at the end.

† For a full account, and detailed references, see G. Castelnuovo (B 1).

‡ $(\epsilon, \eta > 0)$ means "for any given $\epsilon > 0$ and $\eta > 0$ " $\exists n_0$ means, "a number n_0 exists such that."

the probability in question. The arithmetical result was supplied by De Moivre, who showed (*Miscellanea Analytica*, 1733) that

$$P\{s_n = r\} \sim \frac{1}{\sqrt{2\pi npq}} e^{-\frac{(r-np)^2}{2npq}} \quad . \quad . \quad . \quad (3)$$

and deduced

$$P\{s_n \leq r\} \sim \int_{-\infty}^t \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}u^2} du \quad (t\sqrt{npq} = r - np) \quad . \quad (4)$$

De Moivre and Laplace used the latter result to establish Bernoulli's Theorem; a much more elegant proof is the Bienaymé-Tchebycheff one, which is based on the inequality true for all distributions,

$$P\{|x - m| > k\sigma\} \leq \frac{1}{k^2} \quad . \quad . \quad . \quad (5)$$

where m and σ^2 are the mean and variance of the variate x .

This inequality serves also to prove a more general theorem, of which Bernoulli's is a particular case. Laplace and Poisson considered series of independent trials in which the probability of success, instead of being constant, varied from trial to trial. If the probability of success at the i th trial be p_i and s_n denote, as before, the number of successes in the first n trials, then

$$\left. \begin{aligned} E(s_n) &= \sum_{i=1}^n p_i = n\omega_n \text{ say,} \\ E(s_n - n\omega_n)^2 &= \sum_{i=1}^n p_i q_i = \sigma_n^2 \text{ say,} \\ E(s_n - n\omega_n)^4 &= 3\left(\sum_{i=1}^n p_i q_i^2\right) - 6\sum_{i=1}^n p_i^2 q_i^2 + \sum_{i=1}^n p_i q_i^3 \end{aligned} \right\} \quad (6)$$

and

Applying (5), we now find, instead of (2),

$$(\varepsilon, \eta > 0), \exists n_0, P\left\{\left|\frac{1}{n}s_n - \omega_n\right| < \varepsilon\right\} > 1 - \eta \text{ for all } n \geq n_0 \quad (7)$$

This result holds whether ω_n tends to a definite limit or not.

Laplace and Poisson attempted to extend to this more general case De Moivre's result (4), in the form

$$\lim_{n \rightarrow \infty} P\left\{\alpha \leq \frac{s_n - n\omega_n}{\sigma_n} \leq \beta\right\} = \int_{\alpha}^{\beta} \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}u^2} du \quad . \quad (8)$$

where ω_n and σ_n are given by (6), and α and β are independent of n . Subsequent writers, notably Tchebycheff and Markoff, investigated the conditions under which (8) is valid; it was shown that a sufficient condition is the divergence of the series $\sum p_i q_i$.

This result follows also from a much more general theorem, due to Liapounoff, concerning the conditions under which the sum $X_{(n)}$ of a large number n of independent variates ξ_i is approximately normal. Let $E(\xi_i) = 0$, $E(\xi_i^2) = \sigma_i^2$ so that the mean and variance of $X_{(n)}$ are, respectively, zero and

$$\sigma_{(n)}^2 = \sigma_1^2 + \sigma_2^2 + \dots + \sigma_n^2 \quad (9)$$

and let

$$m_{(n)}^{(r)} = E(|\xi_1|^r) + E(|\xi_2|^r) + \dots + E(|\xi_n|^r) \quad (10)$$

Liapounoff showed that if there is any positive value of δ for which

$$\lim_{n \rightarrow \infty} \frac{m_{(n)}^{(2+\delta)}}{\sigma_{(n)}^{2+\delta}} = 0 \quad (11)$$

then

$$\lim_{n \rightarrow \infty} P\left\{\alpha \leq \frac{X_{(n)}}{\sigma_{(n)}} \leq \beta\right\} = \int_{\alpha}^{\beta} \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}u^2} du \quad (12)$$

whatever values (independent of n) α and β may have.

In the Laplace-Poisson case considered above, ξ_i assumes the values $-p_i$ and q_i with probabilities q_i and p_i , so that

$$E(\xi_i^2) = p_i q_i, \quad E(\xi_i^4) = p_i q_i (1 - 3p_i q_i)$$

In this case, therefore,

$$\frac{m_{(n)}^{(4)}}{\sigma_{(n)}^4} = \frac{\sum_{i=1}^n p_i q_i - 3 \sum_{i=1}^n p_i^2 q_i^2}{\left(\sum_{i=1}^n p_i q_i\right)^2}$$

which tends to zero if $\sum p_i q_i$ diverges. In the Bernoulli case $p_i q_i$ has a constant value, so that Liapounoff's theorem supplies a rigid proof of (4).

The theory up to this point may justly be regarded as a natural development of the classical work of Bernoulli and De Moivre; a new train of thought started with Cantelli in 1916, (B 2, B 3). It is tempting to assert, on the strength of Bernoulli's Theorem, that over a long series of trials the ratios of frequencies tend to the ratios of the corresponding probabilities. This is obviously not always true, since each trial in the series, even when q is not zero, may happen to result in a success. We may ask, however, whether the probability that it should be true is unity, and here Bernoulli's Theorem does not help us. All that Bernoulli's Theorem enables us to assert is this, that when n is large, frequencies are approximately proportional to probabilities in the great majority of series of n trials. But it tells us nothing about a series of trials of indefinite length, and without further examination we cannot exclude the possibility that in the

course of every such series there may appear, now and then, values of s_n/n that differ considerably from p , even although, for the corresponding values of n , most of the remaining possible series of results give values of s_n/n that are near to p . Similar doubts arise in the more general case of a varying probability, if we now understand by p the limit, when it exists, of the *average* probability ω_n . *A fortiori*, the doubt applies to the general case with which Liapounoff's theorem is concerned. Given an infinite sequence of variates ξ_i , each measured from its mean, we form the sequence of averages

$$x_{(n)} = \frac{1}{n} X_{(n)} = (\xi_1 + \xi_2 + \dots + \xi_n)/n \quad . \quad . \quad (13)$$

Can we take n large enough to make it morally certain that $x_{(n)}$, $x_{(n+1)}$, \dots , $x_{(n+r)}$, \dots will *all* be negligible?

It was these doubts that Cantelli raised, and resolved. He showed that under fairly wide conditions on the distributions of the ξ 's, it is possible to choose n large enough to make it as nearly certain as we please that the infinity of inequalities

$$|x_{(n+r)}| \leq \varepsilon_{n+r} \quad (r = 0, 1, 2, \dots) \quad . \quad . \quad (14)$$

will all be satisfied. The ε 's, moreover, can be chosen so that as $r \rightarrow \infty$, ε_{n+r} is constantly decreasing and tends to zero, and we are accordingly justified in claiming that $x_{(n)}$ is morally certain to tend to zero. This is the Uniform or Strong Law of Large Numbers.*

The proof of Cantelli's theorem is simple; if P_n be the probability that all of the inequalities (14) will be satisfied, it is easily seen that

$$P_n > 1 - \sum_{r=0}^{\infty} P\{|x_{(n+r)}| > \varepsilon_{n+r}\} \quad . \quad . \quad (15)$$

To complete the demonstration it is necessary to show that the series

$$\sum_{n=1}^{\infty} P\{|x_n| > \varepsilon_n\} \quad . \quad . \quad . \quad (16)$$

is convergent. It will then follow that P_n can, by taking n large enough, be made as near unity as we please.

In the Laplace-Poisson case, the convergence can be proved by using an analogue to the Bienaymé-Tchebycheff inequality, due to Medolaghi,

$$P\{|x - m| > k \cdot \sqrt[4]{\mu_4}\} \leq \frac{1}{k^4} \quad . \quad . \quad . \quad (17)$$

where m and μ_4 are respectively the mean, and fourth moment about

* Wrinch and Jeffreys (B 4) and Bartlett (B 5) have given for the binomial case, proofs of a weaker form of this law; in their form the inequalities (14) are replaced by $|x_{(n+r)}| \leq \epsilon$, where ϵ is fixed as r increases.

its mean, of the variate x . Using (6), and noting that $p_i q_i \leq 1/4$, we have

$$\begin{aligned} P\left\{\left|\frac{s_n}{n} - \omega_n\right| > \varepsilon_n\right\} &\leq \frac{3(\Sigma p_i q_i)^2 - 6\Sigma p_i^2 q_i^2 + \Sigma p_i q_i}{n^4 \varepsilon_n^4} \quad (18) \\ &< \left(\frac{3n^2}{16} + \frac{n}{4}\right) / n^4 \varepsilon_n^4 \\ &< 1/2n^2 \varepsilon_n^4 \end{aligned}$$

If we take $\varepsilon_n = \lambda n^{-v}$, where $v < 1/4$, then $\varepsilon_n \rightarrow 0$, and $\Sigma P\left\{\left|\frac{s_n}{n} - \omega_n\right| > \varepsilon_n\right\}$ converges with $\Sigma(1/2n^2 \varepsilon_n^4)$.

As regards the general case, we have, in place of (18),

$$n^4 \varepsilon_n^4 P\{|x_n| > \varepsilon_n\} \leq \Sigma \mu_4(\xi_i) - 3\Sigma \sigma_i^4 + 3(\Sigma \sigma_i^2)^2 \quad . \quad (19)$$

and it is now necessary, if we are to complete the proof as before, to impose conditions on the distribution of the ξ 's that prevent the second member of (19) from becoming of order $> n^{2+\delta}$ ($\delta < 1$). It will be sufficient, for instance, for the totality of values assumed by all the ξ 's to be finite, or for all the second, and all the fourth, moments of the ξ 's to be of the same order of magnitude.

Kolmogoroff, however, has since shown that a consideration of the second moments σ_i^2 of the variates ξ_i is sufficient, and that the Uniform Law of Large Numbers holds if, and only if, the series $\Sigma(\sigma_i^2/i^2)$ converges (B 6).

De Finetti (B 7, B 8) has extended these results to an important class of sets of dependent variates. He defines as *equivalent variates* any set ξ_i ($i = 1 \dots n$) such that, for all m , the probability that m of them satisfy jointly any given condition is the same for all sub-sets of m . If a function f exists such that*

$$P\left\{\prod_{i=1}^n (x_i \leq \xi_i \leq x_i + dx_i)\right\} = f(x_1 \dots x_n) dx_1 \dots dx_n,$$

then f must be symmetrical in the x 's. Independent variates having the same distribution are a particular case of equivalent variates, but the notion is a more general one. We might, for instance, consider a group of n individuals of the same age and sex living under the same conditions, and take as ξ_i the age at death of the i th individual. The possibility of epidemics makes the ξ 's dependent, but they would still be equivalent.

* The first member of the following equation means "The probability that ξ_1 lies between x_1 and $x_1 + dx_1$, ξ_2 between x_2 and $x_2 + dx_2$, . . . ξ_n between x_n and $x_n + dx_n$."

De Finetti shows that if we form the sequence of averages

$$x_n = \frac{1}{n} X_{(n)} = (\xi_1 + \xi_2 + \dots + \xi_n)/n \quad . \quad (13)$$

then for all r ,

$$P\{|x_{(n+r)} - x_{(n)}| > \varepsilon\} < \frac{\mu_2 - m_2}{\varepsilon^2} \frac{r}{n(n+r)} \quad . \quad (20)$$

$$\sum_{r=1}^{\infty} P\{|x_{(n+r)} - x_{(n)}| > \varepsilon\} < \frac{72}{\varepsilon^2} (\mu_2 - m_2) \sum_{i=1}^{\infty} \frac{1}{i^2} \quad . \quad (21)$$

where

$$\mu_2 = E(\xi_i^2), \quad m_2 = E(\xi_i \xi_j) \quad (i \neq j) \quad . \quad (22)$$

and v is the greatest perfect square less than n . It follows that if the variates have a finite variance, then as $n \rightarrow \infty$, $x_{(n)}$ tends to a limit in the sense of the Uniform Law of Large Numbers. It is no longer the case, however, as with independent variates, that this limit is the same for all sequences. De Finetti shows that the sampling distribution of $x_{(n)}$ tends to a limiting form whose k th moment is, if this expectation is finite, $m_k = E(\xi_1 \xi_2 \dots \xi_k)$. The necessary and sufficient condition for the sequence to have a unique limit is $m_2 = m_1^2$, that is, that the product-moment correlation between any pair of variates should be zero.

The Uniformity Law is primarily an existence theorem, and it is not to be expected that the proofs outlined above will provide very accurate numerical results, any more than the Bienaymé-Tchebycheff inequality (5) provides an accurate value of the binomial tail. Messina (B 9, B 10) has investigated the Bernoulli case more closely with a view to evaluating fairly close lower limits to the P_n of (15), when n is known and the ε 's have been assigned in a particular way. The inequality (15) is used in the derivation of Messina's results, and we have as yet no knowledge of what improvement could be effected by avoiding it. In spite of the theoretical importance of the Uniform Law of Large Numbers, however, it is doubtful whether exact numerical results would be of much practical use.

[In practice we want to know what conclusions may be drawn from the data already collected, rather than what the risk is of being temporarily misled in the course of adding to these data indefinitely. Pearson and Clopper (B 11) have constructed two extremely useful diagrams showing fiducial limits for an *unknown* constant chance p , for all possible values of the observed frequency s_n , and for $n = 10, 15, 20, 30, 50, 100, 250$, and $1,000$. The arrangement of the diagrams makes it possible to interpolate at sight with fair accuracy for other values of n .

The diagrams are based on confidence coefficients of 0.95 and

0.99; in using them repeatedly we are morally certain, in the long run, to be right on at least 95 per cent. and 99 per cent. of occasions, respectively. For confidence coefficients of 0.90 and 0.98, fiducial limits can be calculated from tables of the 5 per cent. and 1 per cent. points of Fisher's z by the following rule:

$$\left. \begin{aligned} \text{Lower Limit} &= n_2/(n_2 + n_1 e^{2z}) \\ \text{Upper Limit} &= n_1' e^{2z'}/(n_2' + n_1' e^{2z'}) \end{aligned} \right\} \quad (23)$$

where z and z' are the tabular values of z for

$$\left. \begin{aligned} n_1 &= 2(n - s_n + 1) & n_2 &= 2s_n \\ n_1' &= 2(s_n + 1) & n_2' &= 2(n - s_n) \end{aligned} \right\} \quad (24)$$

Values of e^{2z} are given by Snedecor (B 12).]

The next important step was made by Khintchine. The Uniform Law tells us, in the Bernoulli case, that it is morally certain that from some point onwards the difference $|s_n - np|$ will be infinitely small in comparison with n . The question arises—what sort of values may this difference be expected to assume? In 1924, Khintchine (B 13, B 14) gave the exact upper limit of the order of magnitude of $|s_n - np|$. Put rigidly, Khintchine's problem was to find a function $\chi(n)$ satisfying the following condition: *

$$(\epsilon, \eta > 0), \exists n_0 = n_0(\epsilon, \eta), P\{C_1 \cdot C_2\} > 1 - \eta \quad (25)$$

where C_1 stands for:

$$\text{"For all } n > n_0, |(s_n - np)/\chi(n)| < 1 + \epsilon \text{"}$$

and C_2 for

$$\text{"For some } n > n_0, |(s_n - np)/\chi(n)| > 1 - \epsilon \text{"}$$

Khintchine showed that the function in question must be equal (or asymptotic) to

$$X(n) = \sqrt{2pqn \log \log n} \quad (26)$$

In the last ten years this result has given rise to wider generations, in analogy with the evolution of De Moivre's result (4) into (15). Khintchine himself effected the first extension; in 1927 (B 15) he showed that in the Poisson case, provided the probabilities p_i and q_i have a non-zero lower bound, the corresponding limiting function is

$$X(n) = \sqrt{\{2 \sum_{i=1}^n p_i q_i \log \log \sum_{i=1}^n p_i q_i\}} \quad (27)$$

* In (B 13) and (B 14) Khintchine uses the ϵ of C_1 and C_2 in (25) also, where η is written. In a note following (B 13), Borel pointed out this restriction; in (B 15) Khintchine showed that it was only apparent.

In 1929 Kolmogoroff (B 16) showed that (27) holds under a rather wider condition than Khintchine's, namely, the divergence of $\Sigma p_i q_i$. Kolmogoroff refers to another publication of Khintchine's, which I have not been able to examine (*The Fundamental Laws of the Theory of Probability*, Moscow, 1927), in which it is suggested that in the general case described on p. 717, the limiting function for the sum $X_{(n)}$ is, in the notation of equation (9),

$$X(n) = \sqrt{2\sigma_{(n)}^2 \log \log \sigma_{(n)}^2} \quad . \quad . \quad . \quad (28)$$

The results (26) and (27) established for the Bernoulli and Poisson cases are in agreement with (28), and Kolmogoroff showed that (28) holds under the conditions

- (i) $\sigma_{(n)} \longrightarrow \infty$.
- (ii) ξ_n can assume only finite values of lower order than

$$\sigma_{(n)} / \sqrt{\log \log \sigma_{(n)}^2}$$

Except in trivial cases, the first of these conditions is necessary, and if the ξ 's are bounded uniformly, it is also sufficient.

In 1931 Lévy (B 17, B 18, B 19) published a simpler proof of Khintchine's result (26) for the Bernoulli case, and pointed out the desirability of extending (28) to the case in which the distributions of the ξ 's are not assumed to be finite. He also gave (B 20), for the Bernoulli case, a more precise result than Khintchine's. Instead of adopting the form given in (26) and (27), we may enunciate Khintchine's result as follows:

The probability that the inequality

$$|s_n - np| > c\sqrt{2npq \log_2 n} \quad . \quad . \quad . \quad (29)$$

will be verified an infinity of times is 0 if $c > 1$ and 1 if $c < 1$.

Lévy's result to a large extent covers the case $c = 1$ as well. He showed that: *

The probability that the inequality

$$|s_n - np| > \sqrt{\{2npq(\log_2 n + c \log_3 n)\}} \quad . \quad . \quad (30)$$

will be verified an infinity of times is 0 if $c > \frac{3}{2}$ and 1 if $c \leq \frac{1}{2}$.

Cantelli (B 21) has recently provided a generalization of (30) which at the same time extends the application of (28) to ξ 's with an infinite range. In the notation of equations (9) and (10), Cantelli's result may be written:

The probability that the infinity of inequalities

$$|X_{(n+i)}| < \sqrt{\{2\sigma_{(n+i)}^2(\log_2 \sigma_{(n+i)}^2 + c \log_3 \sigma_{(n+i)}^2)\}} \quad (i = 0, 1, 2, \dots) \quad (31)$$

* $\log_2 n = \log \log n$, $\log_3 n = \log \log_{-1} n$.

will be satisfied is 0 if $c \leq \frac{1}{2}$ and tends to 1 as $n \rightarrow \infty$ if $c > \frac{1}{2}$, provided that:

- (1) The σ_i 's have a non-zero lower limit
- (2) For some $\delta > 0$, the $m_{(3+\delta)}^{(3+\delta)}$ are bounded above.

What happens in the interval $\frac{1}{2} < c \leq \frac{1}{2}$ is not yet completely known, even in the Bernoulli case. Lévy (B 20) has shown that whatever the value of c in (30), the probability in question can only be 0 or 1—intermediate values are ruled out. As c increases from $\frac{1}{2}$ to $\frac{3}{2}$, the probability must, therefore, at some point change suddenly from 0 to 1. Lévy suggests that the jump probably occurs at $c = 1$, and also that it may be possible to prove some such theorem as the following:

If $\lambda(n)$ stand for some slowly but strictly increasing function, such as $\log n \log_2 n \dots \log_n n \log_{n+1} n$, then the probability that the inequality

$$|s_n - np| > \sqrt{2pqn \log \lambda(n)} \quad . \quad . \quad . \quad (32)$$

will be satisfied an infinity of times is 0 or 1 according as the series $\Sigma \{n\lambda(n)\}^{-1}$ converges or diverges.

It seems likely that with suitable provisos any such theorem could also be extended to Cantelli's general case.

Up to this point we have considered sequences of averages in which each term $x_{(n)}$ is positively correlated with all the preceding ones, owing to the appearance in it of those values of $\xi_1, \xi_2, \dots, \xi_{n-1}$ on which they are based. Cantelli (B 21) points out that his original proof of the Uniform Law applies also to sequences of *uncorrelated* averages

$$x'_{(n)} = \frac{1}{n} X'_{(n)} = \frac{1}{n} (\xi_1 + \xi_2 + \dots + \xi_{n-1} + \xi_n) \quad . \quad (33)$$

where $X'_{(n)}$ is based not only on a random value of a further variate ξ_n of zero expectation, but also on new random values of the preceding variates $\xi_1 \dots \xi_{n-1}$. In this case, if the variates ξ are well behaved, $X'_{(n)}$ will for large n be distributed approximately normally with variance $\sigma_{(n)}^2$, so that if λ_n be large,

$$P\{|X'_{(n)}| \geq \sqrt{2\sigma_{(n)}\lambda_n}\} \simeq \frac{2}{\sqrt{\pi}} \int_{\lambda_n}^{\infty} e^{-t^2} dt \simeq \frac{2}{\sqrt{2\pi}} \frac{e^{-\lambda_n}}{\lambda_n} \quad . \quad (34)$$

The probability P'_n of the joint existence of all the inequalities

$$|X'_{(n+r)}| < \sqrt{2\sigma_{(n+r)}\lambda_{(n+r)}} \quad (r = 0, 1, 2, \dots) \quad . \quad (35)$$

is greater than

$$1 - \sum_{r=0}^{\infty} P\{|X'_{(n+r)}| \geq \sqrt{2\sigma_{(n+r)}\lambda_{(n+r)}}\}$$

and since they are independent conditions, the probability that not all of them are true is

$$1 - \prod_{r=0}^{\infty} [1 - P\{|X'_{(n+r)}| \geq \sqrt{2}\sigma_{(n+r)}\lambda_{(n+r)}\}]$$

Hence (34) suggests, as an analogue to (32), that $\lim_{n \rightarrow \infty} P'_n$ is 1 or 0, according as $\Sigma e^{-\lambda_n}/\lambda_n$ converges or diverges. Cramér (B 22) shows that this is in fact true subject to the condition

$$n^{3/2} m_{(n)}^{(5)} / \sigma_{(n)}^5 < \text{some constant} \quad . \quad . \quad . \quad (36)$$

Glivenko and Kolmogoroff have generalized the investigations into the binomial distribution mentioned above along a rather different path. In the light of a random sample

$$x_1, x_2 \dots x_n (x_1 \leq x_2 \leq \dots \leq x_n)$$

from some univariate parent population, we can construct an empirical cumulative frequency function

$$\begin{aligned} y = F_n(x) &= 0 \quad (x < x_1) \\ &= \frac{k}{n} (x_k \leq x < x_{k+1}) \quad (k = 1 \dots n-1) \\ &= 1 \quad (x \geq x_n) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (37) \end{aligned}$$

The graph of $F_n(x)$ will look like an irregular staircase, and we can compare it with the parental cumulative frequency function

$$y = F(x) = P\{\xi < x\} \quad . \quad . \quad . \quad . \quad . \quad (38)$$

where ξ is the variate sampled.

In the binomial case, we have

$$\begin{aligned} \text{for } x < 0 & \quad F_n(x) = 0, & \quad F(x) = 0, \\ \text{for } 0 \leq x < 1 & \quad F_n(x) = 1 - s_n/n, & \quad F(x) = 1 - p, \\ \text{for } 1 \leq x & \quad F_n(x) = 1, & \quad F(x) = 1, \end{aligned}$$

and the Uniform Law, for instance, tells us that there exists a sequence of ϵ 's decreasing steadily to zero, such that it is almost certain, when n is large enough, that the infinity of inequalities

$$|F(x) - F_{n+i}(x)| < \epsilon_{n+i} \quad (i = 0, 1, 2, \dots)$$

will for all values of x be simultaneously satisfied.

As extensions to the general case of repeated sampling, defining, as a function of the sample Σ_n and the parental distribution $F(x)$, the upper bound

$$M_n(\Sigma_n, F) = \text{Max}|F_n(x) - F(x)| \quad . \quad . \quad . \quad (39)$$

Glivenko (B 23) suggested three related problems :

(A) To prove that, however small ϵ may be,

$$\lim_{n \rightarrow \infty} P\{M_n(\Sigma_n, F) > \epsilon\} = 0 \quad . \quad . \quad . \quad (40)$$

i.e. that a sufficiently large sample is almost certain to reproduce the parent population to any required degree of accuracy :

(B) To prove that

$$P\{\lim_{n \rightarrow \infty} M_n(\Sigma_n, F) = 0\} = 1 \quad . \quad . \quad . \quad (41)$$

i.e. that experimental sampling, indefinitely continued, is morally certain to reproduce the parent population ;

(C) Given λ_n , to find an asymptotic expression, for large n , for $P\{M_n(\Sigma_n, F) > \lambda_n\}$.

(A), (B), and (C) generalize, respectively, Bernoulli's, Cantelli's, and de Moivre's theorems for the Bernoulli case ; (B), if true, implies (A), and should be deducible from the solution of (C).

From a practical point of view, the solution of (C), which Kolmogoroff (B 24) has obtained for *continuous* distributions $F(x)$, is by far the most important of the three problems. It enables us, when we have drawn the graph of $F_n(x)$, to draw two lines parallel to, and equidistant from, that graph, which we can assume, with a given degree of confidence, to enclose between them the graph of $F(x)$. Kolmogoroff shows that $P\{M_n(\Sigma_n, F) < \lambda_n\}$ is the same for all continuous distributions F , and that as $n \rightarrow \infty$,

$$P\{M_n < \lambda/\sqrt{n}\} \sim \Phi(\lambda) = \sum_{-\infty}^{+\infty} (-1)^k e^{-2k^2\lambda^2} \quad . \quad . \quad (42)$$

Since $\Phi(1.6276) = 0.99$, we should need a sample of over 26,000 before we could assert, with 99 per cent. confidence, that $F_n(x)$ was everywhere within 0.01 of $F(x)$.

Glivenko (B 23) supplies a proof of (41) that applies to all distributions, continuous and discontinuous. He shows that it is sufficient to consider the rectangular population, for which

$$\begin{aligned} F(x) &= 0 \quad (x \leq 0) \\ &= x \quad (0 \leq x \leq 1) \\ &= 1 \quad (x \geq 1) \end{aligned}$$

and his proof for this population is somewhat analogous to that outlined above for Cantelli's Uniform Law. He arrives at the inequality

$$P\{M_n(\Sigma_n, F) > \lambda_n\} < \frac{9}{10n^2\lambda_n^6}$$

so that we have to take $\lambda_n = \lambda n^{-v}$ where $v < 1/6$.

De Finetti (B 25) and Cantelli (B 26, B 27) have since suggested methods for simplifying Glivenko's proof of (41). De Finetti deals primarily with the case in which $F(x)$ is continuous; he reduces the problem to a finite number of applications of the Uniform Law, as applied to the Bernoulli case, but succeeds in proving only the weaker result

$$(\varepsilon > 0) \lim_{n \rightarrow \infty} P\{\exists N > n, M_N > \varepsilon\} = 0 \quad . \quad . \quad . \quad (43)$$

Cantelli outlines in (B 26), and gives in fuller detail in the first part of (B 27), a different method from Glivenko's for dealing with discontinuities in $F(x)$. The remainder of (B 27) contains a valuable survey in which Cantelli deals with the considerations that led him to his Uniform Law of Large Numbers, expands his previous work on an abstract theory of probability (see *Recent Advances*, 1933), and discusses the connection between this abstract theory and the classical theory of probability.

De Finetti (B 28) has generalized Glivenko's result (41) to cover the case in which x_1, x_2, \dots, x_n , instead of forming a random sample from a single parent population, are each a random value of one of a set of equivalent variates. If, as in (37), $F_n(x)$ is the empirical cumulative frequency function formed from x_1, x_2, \dots, x_n , then de Finetti shows that by taking n larger than some n_0 , we can make it as nearly certain as we please that the k inequalities

$$F_n(x - \varepsilon) - \varepsilon < F_{n,i}(x) < F_n(x + \varepsilon) + \varepsilon \quad . \quad . \quad . \quad (44)$$

(where $i = 1, 2, \dots, k$) will be jointly satisfied. In (44) ε may have any value, however small, and k any integral value, however large. It follows that as $n \rightarrow \infty$, $F_n(x)$ tends to a limiting form in the sense of the Uniform Law of Large Numbers; since the mean of x_1, x_2, \dots, x_n no longer tends to a unique limit, neither can the limiting form of $F_n(x)$ be unique.

Two further papers, besides that already mentioned, continue Cantelli's study of "an abstract theory of probability." Mazzoni (A 74) deals with the possibility of defining a sequence of geometrical configurations to which correspond probability distributions whose limit is any given distribution. Mazzoni's proof that this can always be done does not, if we understand it rightly, appear to be convincing, and we feel that a rigorous proof has still to be provided.

Belardinelli (B 29) shows how to dissect a square to provide an analogue to the hypergeometric probability distribution that arises in the study of sampling, without replacement, from a population containing marked and unmarked members. As the author reminds us, the differential equation of the Pearsonian frequency curves is analogous to the difference equation of this hypergeometric, and it is

therefore possible that a further study of this configuration would lead to a proof of Mazzoni's theorem, for the particular case of Pearson's system.

Romanovsky (A 95) discusses at some length two problems of a familiar type; it would be interesting to know whether they were suggested by any practical investigation. The problems are:

1. p objects are distributed at random among m pigeon-holes. What is the chance of P_{pq} that exactly $(m - q)$ holes should be empty?

2. mn objects, of which p are marked, are divided into m groups of n . What is the chance Q_{pq} that the marked objects should fall in exactly q groups?

Romanovsky's solutions

$$P_{pq} = \binom{m}{q} \Delta^q O^p / m^p = \binom{m}{q} \left(\frac{q}{m}\right)^p \left[1 - \binom{q}{1} \left(\frac{q-1}{q}\right)^p + \binom{q}{2} \left(\frac{q-2}{q}\right)^p \dots \right]$$

$$Q_{pq} = \left\{ \binom{qn}{p} - \binom{q}{1} \binom{qn-n}{p} + \binom{q}{2} \binom{qn-2n}{p} \dots \right\} \binom{m}{q} / \binom{mn}{p} \quad (44.1)^*$$

can be obtained immediately from the formula for the chance P_1 that at least one of k conditions $C_1 \dots C_k$ should be fulfilled:

$$P_1 = \sum_r P\{C_r\} - \sum_{r,s} P\{C_r C_s\} + \sum_{r,s,t} P\{C_r C_s C_t\} \dots \quad (44.2)$$

Q_{pq} , for instance, is the product of the number of ways of specifying the q groups, by the chance that all p marked objects will fall in them, by the chance that none of them will then lack a marked member; the first two factors are $\binom{m}{q}$ and $\binom{qn}{p} / \binom{mn}{p}$ and the third is, by (44.2),

$$1 - \left\{ \binom{q}{1} \binom{qn-n}{p} - \binom{q}{2} \binom{qn-2n}{p} + \dots \right\} / \binom{qn}{p} \quad (44.3)$$

Romanovsky's calculations for the moments of the distribution of q in the two problems, $\Sigma P_{pq} q^r$ and $\Sigma Q_{pq} q^r$, may also, as in most problems of this type, be shortened considerably by the introduction of the factorial moments $\Sigma P_{pq} q^{(r)}$ and $\Sigma Q_{pq} q^{(r)}$. When p and m tend to infinity so that $\frac{p}{m} \rightarrow \alpha$, while $n (> \alpha)$ remains fixed, the

* These paragraphs were completed later than the rest of the article, the decimal notation has no other significance.

distributions of q are shown to tend to normal curves with mean and variance

$$ma, \sqrt{ma(1-a)}$$

where $a = 1 - e^{-a}$ in the first problem and $1 - \left(1 - \frac{\alpha}{n}\right)^n$ in the second.

J. M. Keynes and W. Burnside, in their books on probability, have pointed out the indeterminate nature of a problem propounded by Boole, which Wilson (A 124) enunciates as follows :

"The *a priori* probabilities of two causes are c_1 and c_2 respectively. The probability that if the cause A_1 occur, an event E will accompany it (whether as a consequence of A_1 or not) is p_1 , and the probability that E will accompany A_2 , if A_2 present itself, is p_2 . Moreover, the event E cannot appear in the absence of both the causes A_1 and A_2 . Required the probability of the event E ."

Wilson points out that statisticians, in spite of themselves, may occasionally be called upon to salvage information from imperfectly preserved data of this sort; he obtains the inequalities

$$\begin{aligned} P\{E\} &\geq \text{Max}\{c_1p_1, c_2p_2, c_1p_1 + c_2p_2 - c_1 - c_2 - q + 1\} \\ P\{E\} &\leq \text{Min}\{c_1p_1 + c_2p_2, c_1p_1 + 1 - c_1 - q, c_2p_2 + 1 - c_2 - q\} \end{aligned} \quad (44.4)$$

where q , the unspecified chance that both A_1 and A_2 should be absent, is limited by the inequalities

$$0, 1 - c_1 - c_2 \leq q \leq \begin{cases} 1 - c_1, 1 - c_2 + c_2p_2 - c_1p_1 \\ 1 - c_2, 1 - c_1 + c_1p_1 - c_2p_2 \end{cases} \quad (44.5)$$

II. Moments and Semi-Invariants of Sampling Distributions.

By W. G. COCHRAN.

The work in 1934 which comes under this heading is small in volume. In particular no paper has come to hand dealing with the general problem of finding the sampling distributions of the usual estimates from a sample of moments and semi-invariants, a subject on which several important ones have appeared in the past few years.

In a paper (C 3) which appeared in 1932, and was reviewed in our article covering that year, Wilks considered the generalization for samples from a multivariate normal population of some well-known statistics, such as, for example, the correlation ratio, which had previously been defined only for bivariate or univariate populations. The problem of finding the sampling distributions of these statistics, when generalized, involves some rather complicated algebra, and in the paper mentioned their moments were found by a method involving variation of the sample number. An alternative method of

solving this and similar problems under rather more general conditions is presented in a more recent paper (A 120). To follow the argument developed there in any detail would require too much space, but a general idea of the method of attack will be given.

For convenience the suffices ij will be assumed to take the values $(1, 2, \dots, t)$, the suffices pq the values $(t+1, t+2, \dots, n)$ and rs the values $(1, 2, \dots, n)$. The simultaneous distribution of the variates x_i is taken to depend on an additional set of variates x_p in such a way that the probability law of the variates x_i is a multivariate normal law of the form

$$f(\bar{x}_i) = ke^{-\sum A_{rs}x_r x_s} d\bar{x}_i \quad \dots \quad (45)$$

where A_{rs} is symmetric and A_{ij} positive definite, $d\bar{x}_i$ standing for the product of the differentials dx_i . The variates x_p are introduced so that the results cover the case, which may arise in regression problems, where some of the independent variates are fixed. Let a sample of N individuals be drawn from the population (45) and in the α th drawing let x_r take the value $x_{r\alpha}$. Then the probability law of the sample is

$$e^{-\sum A_{rs}x_{r\alpha}x_{s\alpha}} d\bar{x}_{i\alpha} \quad \dots \quad (46)$$

except for a constant factor. Write $a_{rs} = \sum_{\alpha=1}^N x_{r\alpha}x_{s\alpha}$. By integrating the expression (46) over all values of $x_{i\alpha}$ ($\alpha = 1, 2, \dots, N$), Wilks obtains the relation

$$\int e^{-\sum A_{rs}x_{r\alpha}x_{s\alpha}} d\bar{x}_{i\alpha} = \Pi^{\frac{Nt}{2}} A^{-\frac{N}{2}} e^{-\sum B_{pq}a_{pq}} \quad \dots \quad (47)$$

where $A = |A_{ij}|$ and $B_{pq} = A_{pq} - \sum_{ij} A_{ip}A_{jq}A^{ij}$, A^{ij} being the inverse of A_{ij} . The relation (47) is of course simply an expression giving the value of the constant factor in (46). The generalizations with which Wilks is concerned can be expressed as functions of determinants similar in structure to $|a_{rs}|$ and its principal minors. Hence the mathematical problem to be solved is to find the mean values of functions of the form $\prod_{\beta=1}^m |a_{\mu_\beta \nu_\beta}|^{k_\beta}$ where the set of determinants is taken from $|a_{rs}|$ and its principal minors. This is equivalent to finding

$$\int \prod_{\beta=1}^m |a_{\mu_\beta \nu_\beta}|^{k_\beta} e^{-\sum A_{rs}x_r x_s} d\bar{x}_{i\alpha} \quad \dots \quad (48)$$

The method of attack is as follows: the equation (47) holds provided A_{ij} is positive definite. Wilks makes a transformation of the matrix A_{rs} such that (i) A_{ij} when transformed remains positive definite, (ii) a set of parameters ξ is introduced. Both sides of (47) are

integrated with respect to the ξ 's from $-\infty$ to $+\infty$, and by suitable choice of the transformation this yields on the left-hand side of (47) an expression of the form (48) for $m = 1$ and $k_\beta = -\frac{1}{2}$ and on the right-hand side of (47) an integral which can be evaluated. The operator which produces this transformation is called by Wilks a moment generating operator. The case $m = 1$, $k_\beta = -(\lambda/2)$ (where λ is a positive integer) is obtained by repeated applications of the same operator and the case $m = 1$, $k_\beta = +(\lambda/2)$ by definition of an inverse operator. The general case $m > 1$ is solved by applying a set of operators in succession.

In the sections which deal with applications of the method, Wilks obtains the moments of (i) a generalized variance of deviations from regression functions, (ii) the generalization of "Student's" ratio, (iii) the multiple correlation coefficient, and (iv) the generalized Neyman-Pearson λ_H criterion for k samples.

In two short notes Ayyangar (A 3), (A 4) provides easy proofs of the recurrence formulæ obtained by Frisch (C 1) and K. Pearson (C 2) for the moments of the point binomial and of the hypergeometric series respectively, deducing in the process one or two results which are new. The methods of attack used have the advantage of being applicable to complete and incomplete moments alike.

E. S. Martin (A 73) considers the problem of fitting by the method of moments a curve to a set of grouped data in which the start of the frequency distribution is not known. An example occurs, for instance, in the frequency distribution of the value of houses for income-tax purposes. As officially published this is given in the frequency groups £0-20, £20-40, etc., but no house is valued at nothing per annum. If the data are grouped in intervals of size h , the method assumes that the range of the first group is actually λ_h . Three methods are suggested for finding λ . In the first two, a curve of the fifth degree is fitted to the first five ordinates of Z , the integral of the frequency distributions from x upwards. This determines the constants of the curve in terms of λ , and the value of λ is obtained either by making the observed and calculated sixth ordinates agree as closely as possible, or by using the fact that the original frequency distribution starts with a zero ordinate. In the third method λ is found by fitting a curve of the form

$$Z = N + Axe^{ax+bx^2} \dots q > 0 \quad \dots \quad (49)$$

where the number of constants fitted is varied according as 3, 4, 5, 6 or 7 observed frequencies are used. Tables are given to facilitate the numerical computation of λ in each case. None of the methods is in all cases superior to the others but the third appears to give generally the best results, and can be used for either asymptotic or non-

asymptotic frequency distributions. The value of λ having been estimated, the moments of the observed distribution are corrected for the fact that the first group is of length λh instead of h and the curve fitting proceeds. The examples given are numerous and well chosen.

III. *Exact Sampling Distributions.*

EDITORIAL.

Not a great deal has come to our notice in this section, but there are two contributions worthy of note.

In a series of papers extending over the years 1933 and 1934 (see References A 45-49 of *our last article* and A 56-59) Gumbel has given a good account of the frequency distribution of the m th value in order of magnitude in a sample of N . The substance of these papers formed the subject of some lectures given at the Institut Henri Poincaré in the winter of 1933-34, and have been reprinted under one cover (A 58). The author starts from the well-known distribution of the m th value from the top

$$\binom{N}{m} W(x)^{N-m} (1 - W(x))^{m-1} w(x) dx \quad . \quad . \quad (50)$$

where $W(x) = \int_{-\infty}^x w(z) dz$, $w(x) dx$ being the initial frequency distribution.

When x becomes large $w(x)$ is assumed to decline exponentially or faster, or in other words $|(w'(x))/(w(x))|$ remains constant or increases. This is sufficient to ensure that all the moments of $w(x)$ remain finite.

Under these conditions the modes (\tilde{u}_m , $m\tilde{u}$) of the distributions of the m th values from the top and bottom respectively when N is large are given by

$$\begin{aligned} W(\tilde{u}_m) &= 1 - \frac{m}{N} \\ W(m\tilde{u}) &= \frac{m}{N} \quad . \quad . \quad . \quad . \quad . \quad (51) \end{aligned}$$

respectively.

He examines carefully the way in which the modal values and their probabilities change with increasing m and N , and compares the nature of the distributions for consecutive values of m and N . He reaches the important conclusion that provided the logarithmic differential of $w(x)$ increases in absolute value with x , the distribution of the m th values will become more and more concentrated round the mode with an increasing number of observations.

He shows that if both m and N become large, their ratio remaining

finite, the ultimate distribution of the m th observation is normal, but if m remains finite while N increases indefinitely the limiting distribution of the m th value from the top is given by

$$\frac{m^m}{(m-1)!} e^{-my - m\epsilon^{-y}} dy \quad . \quad . \quad . \quad (52)$$

where

$$y = \frac{N}{m} w(\tilde{u}_m)(x - \tilde{u}_m)$$

The corresponding distribution of the m th value from the bottom is given by changing the sign of y in (52). When $m = 1$ this is Fisher and Tippett's limiting form (D 1) for the distribution of the greatest and least values of the sample. Gumbel considers this distribution in great detail; he works out its mean, standard deviation, other moments, skewness, β_1 and β_2 .

If the modal values given by (51) closely satisfy the limiting relations

$$\begin{aligned} \frac{w(\tilde{u}_m)}{1 - W(\tilde{u}_m)} &= -\frac{w'(\tilde{u}_m)}{w(\tilde{u}_m)} \\ \frac{w({}_m\tilde{u})}{W({}_m\tilde{u})} &= \frac{w'({}_m\tilde{u})}{w({}_m\tilde{u})} \quad . \quad . \quad . \quad (53) \end{aligned}$$

he says that the limiting form is sufficiently accurate. Fisher and Tippett have, however, shown that for normal samples the actual distribution of the greatest value is only represented by the limiting form with any great accuracy for samples of a billion or more and have given a penultimate form which may be used for smaller samples.

Lüders (A 72) shows that if an event (such as an accident) occurs at random and if each event may give rise either to 1, 2, 3 . . . , r , or more individual cases (*e.g.* individual accidents) then the frequency of time intervals containing r individual events will be

$$P_r = e^{-h_1 - h_2 - \dots - h_r - \dots} \sum_{\nu_1 + 2\nu_2 + \dots + r\nu_r = r} \frac{h_1^{\nu_1} h_2^{\nu_2} \dots h_r^{\nu_r}}{\nu_1! \nu_2! \dots \nu_r!} \quad . \quad . \quad (54)$$

Alternatively P_r is the coefficient of z^r in

$$f(z) = e^{-h_1 - h_2 - h_3 - \dots} e^{h_1 z + h_2 z^2 + h_3 z^3 + \dots} \quad . \quad . \quad (55)$$

where $h_1, h_2, h_3 \dots$ are the mean number of events per time interval giving rise respectively to 1, 2, 3 . . . individual cases.

He considers a number of particular cases of this distribution, for instance

$$\begin{aligned} h_2 &= h_3 = h_4 = \dots = 0 \\ h_3 &= h_4 = h_5 = \dots = 0 \\ h_4 &= h_5 = h_6 = \dots = 0 \quad . \quad . \quad . \quad (56) \end{aligned}$$

The first of these is, of course, the Poisson series.

$$\text{If} \quad h_n = \frac{h d^{n-1}}{n(1+d)^n} \quad . \quad . \quad . \quad (56 \text{ bis})$$

the distribution gives rise to the negative binomial

$$f(z) = (1+d)^{-\frac{h}{d}} \left(1 - \frac{dz}{1+d}\right)^{-\frac{h}{d}} \quad . \quad . \quad . \quad (57)$$

of which the mean is h . Greenwood and Yule (D 2) showed some years ago that the distribution of accidents would be a negative binomial if accidents occurred at random but if individual susceptibilities varied so that the Poisson parameter had a Pearson Type III distribution. Lüders' result shows that a negative binomial might have another interpretation—that multiple accidents occur with average frequencies given by (56 bis).

A slightly more general distribution than the negative binomial is also considered, containing one more parameter—that in which

$$h_2 = p/2, h_3 = pq/3, h_4 = pq^2/4, . . . h_n = pq^{n-2}/n$$

which reduces to the negative binomial when $p = q$.

Some numerical examples follow, but in applying the χ^2 test the author does not reduce n' by the number of parameters fitted. His results, therefore, require careful scrutiny.

There is no doubt, however, that in the classical case of the distribution of blood-corpuscles in 400 squares of a hæmacytometer this last distribution gives a somewhat better fit than a Poisson series pointing to the tendency of corpuscles to occur in groups.

IV. *Orthogonal Polynomial Theory and Least Squares.*

By W. G. COCHRAN and J. O. IRWIN.

Papers by W. Andersson (A 1) and Dieulefait (A 40) both deal with the subject of non-linear regression. Several writers, amongst whom may be mentioned K. Pearson (E 2) and Neyman (E 1) have previously given a mathematical presentation of general formulæ for estimates of the unknown parameters in a polynomial fitted as a regression line by least squares. In fitting a polynomial of degree n , estimated moments of order $2n$ in the independent variates x are required. When the problem is looked at from the standpoint of the bivariate frequency distribution, these estimated high order moments are known to have large sampling variances. Accordingly Wicksell (E 3) suggested in 1930 that the moments of a suitably chosen frequency function might be inserted in the least square expressions instead of the estimated higher marginal or x moments, that is, before fitting the

regression some simple form of distribution should be fitted to the observed values of x . The solution obtained by this method does not give a strict least-squares adjustment of the observed array means of y . Wicksell suggested, however, that by a slight adjustment the method might be turned into a strict least-square solution.

The paper by Andersson (A 1) shows how this adjustment may be made, working out the normal and Pearson type III cases as an example. He gives three numerical examples, and from the results of these considers that there is little, if anything, to be gained by making the adjustment.

The paper by Dieulefait (A 40) first obtains, by means of the theory of orthogonal functions, some results by previous writers on the expansion of a univariate frequency function in series, of which the Gram-Charlier series are the best known. In the part which claims to be new, he considers an expansion of the bivariate frequency function $f(x, y)$ in a series of the form

$$f(x, y) = \psi(x)\phi(y)[1 + \sum_{sj} w_{sj} X_s(x) Y_j(y)] \quad . \quad . \quad (58)$$

where $\psi(x)$, $\phi(y)$ are the marginal frequency distributions of x and y respectively, and $X_s(x)$, $Y_j(y)$ are sets of functions orthogonal to $\psi(x)$ and $\phi(y)$ respectively. The idea behind this expansion is that by specifying particular forms for $\psi(x)$ and $\phi(y)$ a development in series of a bivariate frequency function will be obtained analogous to the well-known developments of a univariate function. From this expansion he deduces formal expressions for the regression line of y on x , the correlation ratio $\eta_{y,x}$, $\sqrt{\beta_1(y_x)}$ and $\beta_2(y_i)$. The paper as it stands belongs rather to the subject of pure mathematics than to statistics, but a further paper on applications is promised. Dieulefait admits, however, that the advantages of expansions of the form (58) from the practical point of view of curve-fitting are open to dispute.

One of the most general discussions of the method of least squares that we have seen, is given by Deming (A 34-36). He supposes that there are n observations on q different kinds of quantities, $x_1, x_2 \dots x_n; x_{n+1}, x_{n+2} \dots x_{2n}; \dots; \dots x_{qn}$. For example, $x_1 \dots x_n$ might be pressure observations, $x_{n+1} \dots x_{2n}$ might be volume observations, $x_{2n+1} \dots x_{3n}$ might be temperature observations or $x_1 \dots x_n$ might be n observations of height, $x_{n+1} \dots x_{2n}$ might be n observations of body weight. x_i is supposed to have the weight w_i and r_i to be its adjusted value. Then the general problem of the method of least squares is to minimize

$$\sum w_i (r_i - x_i)^2 \quad . \quad . \quad . \quad . \quad . \quad (59)$$

where there may be a number of equations of condition between the r 's and (say) p unknown parameters $a, b \dots p$, and if the parameters are not all independent, there will be equations of condition between these also. The equations of condition are expressed by the relations

$$F^h(r_1, r_2 \dots r_{qn}; a, b \dots, p) = 0 \quad h = 1, 2 \dots m \quad . \quad . \quad (60)$$

$$F^h(a, b \dots p) = 0 \quad h = m + 1, m + 2 \dots m + l \quad . \quad (60 \text{ bis})$$

By the use of approximate values of the parameters the equations of condition may be made linear in form and can then be minimized in the usual way by the use of indeterminate multipliers, leading to a series of linear equations in the r 's, the parameters and the indeterminate multipliers. If some of the observations are without error, the situation can be met by making their weights infinite and $r_i - x_i$ zero. The corresponding terms will disappear from (59).

As an example we may take the well-known case of fitting a straight line $y = a + bx$ to n points. In this case $y_h = x_{n+h}$ ($h = 1, 2 \dots n$) and there are n equations of condition

$$r_{n+h} = a + br_h \quad (h = 1, 2 \dots n) \quad . \quad . \quad (61)$$

If the x 's are not subject to error

$$\left. \begin{array}{l} w_h = \infty \\ r_h - x_h = 0 \end{array} \right\} \quad h = (1, 2 \dots n) \quad . \quad . \quad (62)$$

and we are led to the ordinary expression for the regression line.

Deming gives a number of good examples. The effect of weighting is illustrated by fitting the circle

$$(x - a)^2 + (y - b)^2 = c^2$$

to five points (i) when the x 's and y 's have equal weights, (ii) when the y 's only are subject to error, (iii) when the x 's only are subject to error.

Particularly interesting, especially to physicists, is the treatment of the laws represented by

$$ya^x = b, \quad yz^x = b, \quad yz^x = w$$

where a, b are parameters and x, y, z, w are observed co-ordinates. The last three equations are the ones needed in the determination of e and h (the charge on an electron and Planck's constant) (i) when neither e nor h are directly observed (here $a = e, b = h$), (ii) when direct observations on e are included (here $z = e, b = h$), (iii) when direct observations on both e and h are included (here $z = e, w = h$). The normal equations are set up and illustrated with and without forcing the satisfaction of the condition

$$\frac{hc}{2\pi e^2} = 137 \quad . \quad . \quad . \quad . \quad (63)$$

Deming also treats the problem of curve fitting, and shows that if a curve has been fitted to n points, V_x, V_y being the residuals, n_x, n_y the number of observations made on each co-ordinate, w_x, w_y the weights at the point x, y , then

$$\frac{1}{\sigma^2} \Sigma (w_x V_x^2 + w_y V_y^2) \dots \dots \dots (64)$$

is distributed as χ^2 with $(n - p)$ degrees of freedom, p being the number of parameters in the empirical formula for the curve and σ the root mean square error of an observation of unit weight.

If σ is known, the χ^2 test provides a test of goodness of fit for the empirical formula, if σ is not known by assuming that χ^2 has its average value $(n - p)$, we obtain the estimate of σ

$$\frac{1}{(n - p)} \Sigma (w_x V_x^2 + w_y V_y^2) \dots \dots \dots (65)$$

This is in fact what is usually done in text-books on least squares. It assumes that the empirical formula selected does in fact fit. In the course of the investigation it is shown that if U_x, U_y are the true errors at the point x, y then

$$\Sigma (w_x U_x V_x + w_y U_y V_y) = 0 \dots \dots \dots (66)$$

The remaining papers on this subject, which have come to our notice, deal with points of an elementary character. One may be mentioned.

Smith (A 103) considers the problem of fitting a polynomial to a set of data, where the criterion to be used is that the greatest deviation between any observation and the curve shall be as small as possible. The least square solution does not in general satisfy this criterion. The data are first graphed, and the points which appear to lie farthest from a curve of the order which is to be fitted are selected by eye. The number of outlying points chosen is two more than the degree of the curve, and they are taken to lie alternately on opposite sides of the curve. If y_1, \dots, y_{n-1} are the points chosen and $f(x)$ is the polynomial, of degree $(n - 1)$, Smith shows that the polynomial for which the maximum deviation is least is that which makes

$$y_1 - f(x_1) = f(x_2) - y_2 = \dots = \varepsilon \dots \dots (67)$$

This polynomial may be easily found. For if $F(y_1, y_2 \dots y_{n+1}, x)$ is the Lagrangian polynomial of order n through the outlying points,

$$f(x) = F(y_1, y_2 \dots y_{n-1}, x) - \varepsilon F(1, -1, 1 \dots) \dots \dots (68)$$

where ε is so chosen that the coefficient of x^n in $f(x)$ vanishes.

Explicit expressions for ε and the coefficients in $f(x)$ are given.

When the curve has been fitted it may be verified whether the correct set of outlying points has been chosen, and if the maximum deviation is considered too large a curve of higher order may be fitted by the same method.

V. *The Theory of Estimation ; and Statistical Inference.*

EDITORIAL.

(a) A paper by R. A. Fisher (A 45) on two new properties of mathematical likelihood suggests that it would be worth while attempting to restate here the present position of the theory of estimation.

A *statistic* is, of course, an estimate made from a sample of a parameter on which the specification of the population from which the sample is drawn depends. It is *consistent* if its value tends with increasing size of sample to the value of the parameter. It is *efficient* if its variance in large samples is as small as possible. It is *sufficient* if no other statistic calculable from the sample can provide any further information about the parameter. A statistic T_1 is sufficient for estimating some parameter θ when, if T_2 is any other statistic, the distribution of T_2 for a given value of T_1 does not involve θ . This will be the case when if $f(\theta, T_1, T_2)dT_1dT_2$ is the joint sampling distribution of T_1 and T_2

$$f(\theta, T_1, T_2) = \phi(\theta, T_1)\psi(T_1, T_2) \quad . \quad . \quad (69)$$

It will also be the case when if $F(\theta, x_1, x_2 \dots x_n)$ is the likelihood of θ for a given sample

$$F(\theta, x_1, x_2 \dots x_n) = \phi(\theta, T_1)\psi(x_1, x_2 \dots x_n) \quad . \quad (70)$$

where the function ψ does not involve θ .

The *amount of information* in a sample (or in a single observation) is defined as follows :

If A_1/n is the variance of an efficient statistic in large samples, the amount of information in the sample is n/A_1 and the amount of information in a single observation is $1/A_1$. Provided, as is usual, the limiting distribution of the statistic in large samples is normal it is known that

$$\frac{n}{A_1} = -E\left(\frac{\partial^2 L}{\partial \theta^2}\right) = E\left[S\left(\frac{dl}{d\theta}\right)^2\right] = S\left[E\left\{\frac{1}{y}\left(\frac{dy}{d\theta}\right)\right\}^2\right] \quad . \quad (71)$$

where $L = S(\log y)$ is the logarithm of the likelihood of the parameter, given a sample of n values, $l = \log y$ is the logarithm of the

likelihood, given one value, S denoting summation over all the sample values. If the distribution of x is continuous we have

$$\frac{n}{A_1} = n \int \frac{1}{y} \left(\frac{dy}{d\theta} \right)^2 dx \quad . \quad . \quad . \quad (72)$$

The relations (71) and (72) may now be used to define the amount of information in a sample, or in one observation, and it is easy to see on this definition that the amount of information provided by a combination of two or more observations (from the same or different frequency distributions) is the sum of the amounts of information provided by each separately.

The amount of information supplied by any statistic (calculated from a sample of n values), is the amount of information in a single observation from its sampling distribution and will, therefore, be given by

$$E \left\{ \left(\frac{dl_2}{d\theta} \right)^2 \right\} \quad \text{where } l_2 = \log y_2 \quad . \quad . \quad . \quad (73)$$

and $df = y_2 dx_2$ is its sampling distribution. The expression (73) will, in general, be less than (72). If the statistic is *efficient*, however, the ratio of (73) to (72) tends to unity with increasing size of sample, though the value of their difference may not tend to zero. If the statistic is *sufficient* the two expressions will be equal. Thus a sufficient statistic uses all the information available even in small samples, while if it is *efficient*, but *not sufficient* there is a certain loss of information for all samples of finite size. The maximum likelihood solution always gives an efficient estimate, while if a sufficient statistic exists it will always be given by the method of maximum likelihood. It is worth while outlining the method by which these results were reached by Fisher (F 2).

If T is any statistic used as an estimate of θ , the probability Φ of T having any assigned value, will be the sum of the probabilities of those samples which yield the said value of T , or

$$\Phi = S(\phi) \quad . \quad . \quad . \quad . \quad (74)$$

where S stands for summation over all the samples which yield the same value for the statistic T . Also if T is in large samples normally distributed with variance σ^2

$$\frac{\partial^2}{\partial \theta^2} \log \Phi = - \frac{1}{\sigma^2} \quad . \quad . \quad . \quad . \quad (75)$$

Further $\frac{1}{n} \frac{\partial^2}{\partial \theta^2} \log \phi$ will tend to a fixed limit $-A$ ($= -1/(A_1)$) in large samples, and if $\hat{\theta}$ is the maximum likelihood estimate

$$\frac{\partial}{\partial \theta} \log \phi = - nA(\theta - \hat{\theta}) \quad . \quad . \quad . \quad (76)$$

Now let $M(u)$ stand for the mean value of u in the group of samples for which T is constant then

$$\begin{aligned} M\left(\frac{\partial^2}{\partial \theta^2} \log \phi\right) &= M\left\{-\frac{\phi'^2}{\phi^2} + \frac{\phi''}{\phi}\right\} \\ &= -\frac{S\left(\frac{\phi'^2}{\phi}\right)}{S(\phi)} + \frac{S(\phi'')}{S(\phi)} \quad \dots \quad (77) \end{aligned}$$

$$M\{n^2 A^2 (\theta - \hat{\theta})^2\} = \frac{S\left\{\frac{\phi'^2}{\phi}\right\}}{S(\phi)} \quad \dots \quad (78)$$

$$M\{-nA + n^2 A^2 (\theta - \hat{\theta})^2\} = \frac{S(\phi'')}{S(\phi)} \quad \dots \quad (79)$$

$$M\{-nA(\theta - \hat{\theta})\} = \frac{S(\phi')}{S(\phi)} \quad \dots \quad (80)$$

$$\begin{aligned} \text{Now } \frac{1}{\sigma^2} &= -\frac{\partial^2}{\partial \theta^2} \{\log \Phi\} = \frac{S^2(\phi')}{S^2(\phi)} - \frac{S(\phi'')}{S(\phi)} \\ &= M^2\{-nA(\theta - \hat{\theta})\} - M\{n^2 A^2 (\theta - \hat{\theta})^2\} + nA \quad \dots \quad (81) \end{aligned}$$

$$\text{or } \frac{1}{n\sigma^2} = A - nA^2 V'(\hat{\theta}) \quad \dots \quad (82)$$

where $V'(\hat{\theta})$ is the variance of $\hat{\theta}$ in the group of samples for which T is constant. Now when $T = \hat{\theta}$, $V'(\hat{\theta}) = 0$ and $(1/n\sigma^2) = A$ otherwise $\frac{1}{n\sigma^2} < A$ and $\sigma^2 > (1/nA)$. Hence the maximum likelihood estimate makes σ^2 as small as possible and is an efficient estimate.

Again the amount of information provided by a single value of T will be

$$\Sigma \left\{ \frac{\Phi'^2}{\Phi} \right\} \quad \dots \quad (83)$$

Σ standing for summation over all possible different values of T .

If every possible sample, having frequency ϕ gave a different value of T , the amount of information provided would be $\Sigma S\left\{\frac{\phi'^2}{\phi}\right\}$. The difference is

$$\Sigma \left\{ S\left(\frac{\phi'^2}{\phi}\right) - \frac{\Phi'^2}{\Phi} \right\}$$

$$\text{or } \Sigma \left\{ S\left(\frac{\phi'}{\phi} - \frac{\Phi'}{\Phi}\right)^2 \right\} \quad \dots \quad (84)$$

This latter quantity is essentially positive, so we learn that the information provided is greatest when every sample provides a different value of T , otherwise there is some loss of information.

Further we note (84) is equal to the variance of $\frac{\partial L}{\partial \theta} \left(= \frac{\partial}{\partial \theta} \log \phi \right)$ when T is constant. If, therefore, those samples for which $\frac{\partial L}{\partial \theta}$ is constant are the same as those for which T is constant for all values of θ , there is no loss of information in using T (otherwise there will be loss of information). In this case the maximum likelihood solution will give a sufficient statistic. For $\frac{\partial L}{\partial \theta}$ will be a function of θ and T only or

$$\frac{\partial L}{\partial \theta} = f(T, \theta) \quad . \quad . \quad . \quad . \quad . \quad (85)$$

Now when $\frac{\partial L}{\partial \theta} = 0 \quad \theta = \hat{\theta}$ or

$$f(T, \hat{\theta}) = 0 \quad . \quad . \quad . \quad . \quad . \quad (86)$$

It follows that T is a function of $\hat{\theta}$ and that $\frac{\partial L}{\partial \theta}$ is a function of θ and $\hat{\theta}$ only, or

$$\frac{\partial L}{\partial \theta} = f_1(\theta, \hat{\theta}) \text{ say } \quad . \quad . \quad . \quad . \quad . \quad (87)$$

This is true for all values of θ , hence integrating

$$L = \int f_1(\theta, \hat{\theta}) d\theta + f_2(x_1, x_2 \dots x_n) \quad . \quad . \quad . \quad (88)$$

where the latter function does not involve θ

or $\phi = f_3(\theta, \hat{\theta}) f_4(x_1, x_2 \dots x_n) \dots$ say $\quad . \quad . \quad . \quad (89)$

and $\hat{\theta}$ is, therefore, a sufficient statistic.

Fisher has calculated the loss of information in using an efficient but not sufficient statistic for the case of large samples. It is somewhat greater for efficient statistics other than the maximum likelihood solution.

For the maximum likelihood solution ($\theta = \hat{\theta}$)

$$\frac{\partial L}{\partial \theta} = 0 \quad . \quad . \quad . \quad . \quad . \quad (90)$$

and hence to a first approximation

$$\frac{\partial L}{\partial \theta} = (\theta - \hat{\theta}) \frac{\partial^2 L}{\partial \theta^2} = (\theta - \hat{\theta}) \frac{\partial^2 L}{\partial \theta^2} \quad . \quad . \quad . \quad (91)$$

$(\theta - \hat{\theta})$ being of order $n^{-\frac{1}{2}}$.

The variance of $\frac{\partial L}{\partial \theta}$ in a set of samples for which $\hat{\theta}$ is constant is therefore $(\theta - \hat{\theta})^2$ times the variance of $\frac{\partial^2 L}{\partial \theta^2}$ within the set. Calling

this variance $V_1\left(\frac{\partial^2 L}{\partial \theta^2}\right)$ the variance of $\frac{\partial L}{\partial \theta}$ in all sets for which θ is constant will be

$$E\left\{(\theta - \hat{\theta})^2 V_1\left(\frac{\partial^2 L}{\partial \theta^2}\right)\right\} \text{ for varying values of } \hat{\theta}.$$

$$\text{Now } V_1\left(\frac{\partial^2 L}{\partial \theta^2}\right) = V_1\left(\frac{\partial^2 L}{\partial \theta^2}\right) + (\theta - \hat{\theta}) V_1'\left(\frac{\partial^2 L}{\partial \theta^2}\right) . . . (92)$$

and is constant to the order of approximation considered.

Hence

$$E\left\{(\theta - \hat{\theta})^2 V_1\left(\frac{\partial^2 L}{\partial \theta^2}\right)\right\} = V_1\left(\frac{\partial^2 L}{\partial \theta^2}\right) V(\hat{\theta}) = V_1\left(\frac{\partial^2 L}{\partial \theta^2}\right) V(\hat{\theta}) . . . (93)$$

or the loss of information will be measured by $V(\hat{\theta})$ times the variance of $\frac{\partial^2 L}{\partial \theta^2}$ in sets for which θ is constant. From this expression the loss of information may be calculated in particular cases.

The information lost may be recovered by the use of *ancillary statistics*. An ancillary statistic is an estimate calculable from a sample which, while throwing no light on the value of the parameter to be estimated, helps to determine (and possibly improve) its accuracy. The simplest example of an ancillary statistic is the sample number. In the present case, if θ is the maximum likelihood estimate, the information may be recovered by the use of $\frac{\partial^2 L}{\partial \theta^2}$ is an ancillary statistic. In showing how this is done Fisher gave a simple *lemma* to which the following is equivalent.

If w is the weight of a normally distributed observation x in a particular set of samples, but if w varies somewhat from one set to another; the variance of x in all such sets will be $E\left(\frac{1}{w}\right)$ the mean value of $\frac{1}{w}$ in all such sets. Consequently the loss in weight due to using the average variance instead of the true variance in one such set is

$$w - \left\{1/E\left(\frac{1}{w}\right)\right\} (94)$$

Now if w' be the mean value of w in all such sets and $w = w' + \varepsilon$, it is easy to see that the expression (94) becomes

$$\begin{aligned} w' + \varepsilon - \frac{1}{E\left\{\frac{1}{w'} - \frac{\varepsilon}{w'^2} + \frac{\varepsilon^2}{w'^3}\right\}} &= w' + \varepsilon - \frac{w'}{1 + \frac{V(w)}{w'^2}} \\ &= \varepsilon + \frac{V(w)}{w'} \text{ approximately} . . . (95) \end{aligned}$$

Hence the average loss of weight is $\{V(w)\}/w'$.

Now in large samples the variance of $\hat{\theta}$ is $1/[E\{L''(\hat{\theta})\}]$ where $L''(\hat{\theta})$ is the logarithm of the likelihood of θ when $\theta = \hat{\theta}$. In a set of samples for which $L''(\hat{\theta})$ is constant the variance of $\hat{\theta}$ will be $1/V\{L''(\hat{\theta})\}$ and the average variance in all such sets will be $E\{1/V\{L''(\hat{\theta})\}\}$ which is equal to $1/E\{L''(\hat{\theta})\}$ to the order of approximation considered.

By the previous lemma, the *average* loss in weight due to using the average variance instead of the true variance will be

$$\frac{V\{L''(\hat{\theta})\}}{E\{L''(\hat{\theta})\}} = V(\hat{\theta})V\{L''(\hat{\theta})\} \quad . \quad . \quad . \quad (96)$$

$V\{L''(\hat{\theta})\}$ is in general greater than $V_1\{L''(\hat{\theta})\}$ but tends to equality with it in large samples, hence the expression (96) is simply the quantity which has already been found to measure the loss of information. Hence the information has been recovered by the use of the ancillary statistic. It is to be noted that the estimate ($\hat{\theta}$) of θ , is the same whether the ancillary statistic is used or not; but the ancillary statistic serves to increase its precision.

The reader may find this easier to follow if he considers the elementary case of a variate y which has linear regression on another variate x with equal scatter of arrays. The variance of y for given x is $\sigma_y^2(1 - r^2)$, and the variance of the mean of n such values when x is given is $\frac{1}{n}\sigma_y^2(1 - r^2)$ while in general the variance of \bar{y} is $\frac{1}{n}\sigma_y^2$. If x happens to be equal to \bar{x} then the corresponding y will be \bar{y} and its variance will be $\frac{1}{n}\sigma_y^2(1 - r^2)$. Here \bar{x} is the ancillary statistic. It throws no light on the mean value of y , but serves to improve the precision of the estimate made.

Fisher has generalized the above process for the case of a large sample subdivided into several large sub-samples, and has shown how, in a precisely similar manner the several ancillary statistics $L''(\hat{\theta}_p)$ where $\hat{\theta}_p$ is the maximum likelihood solution of the p th sub-sample, may be used to recover the information lost by using the maximum likelihood estimate $\hat{\theta}$ from the pooled data.

In small samples, where there is no sufficient statistic, the information cannot in general be recovered by the use of one ancillary statistic, to do this requires a consideration of the whole course of the likelihood function. In the paper under review, Fisher

I. Gives a general expression for the sampling distribution of all sufficient statistics.

II. Shows that it is when and only when the populations under consideration depend on a single parameter for which a

sufficient statistic exists that there will be tests of significance of the kind termed by Neyman and Pearson, uniformly most powerful. (In our article for 1932 we showed that for populations depending on a single parameter, there will only be a uniformly most powerful test when a sufficient statistic exists. This argument is here carried a stage further.) *

III. Shows how, in certain cases when no sufficient statistic exists, ancillary information supplied by the observations may be used to recover the information lost.

I and III will be considered in detail. The expression mentioned in I is derived as follows: The equation of maximum likelihood must have a solution $\phi(T) = A$, where A is a symmetric function of the observations not involving the parameter θ .

If there is a sufficient statistic the expression $\frac{\partial}{\partial \theta} \log L$ is of the form

$$C\{A\psi'(\theta) - \phi(\theta)\psi'(\theta)\} \dots \dots \dots (97)$$

where it is not difficult to show $C = n$, the sample number. Hence

$$\log L = nA\psi(\theta) - n\int \phi(\theta)d\psi(\theta) + B$$

where B is a symmetric function of the observations. Since $\log L$ is the sum of expressions involving each observation singly

$$nA = S(X) \qquad B = S(X_1)$$

where X, X_1 are functions of the individual observations x . Hence

$$L = L(\psi) = e^{-n\int \phi(\theta)d\psi(\theta)} e^{\psi(\theta)S(X)} e^{(S(X_1))} \\ \frac{L(\psi)}{L(\psi + it)} = e^{-itS(X)} e^{nF_1(\psi + it) - nF_1(\psi)} \dots \dots \dots (98)$$

where

$$F_1(\psi) = \int \phi d\psi.$$

But the frequency of the variate X must be

$$e^{-F_1(\psi)} e^{X\psi} e^{X_1} \frac{dx}{dX}.$$

Integrating this over the whole range of values of X gives unity, therefore

$$\int e^{X\psi} e^{X_1} \frac{dx}{dX} dX = e^{F_1(\psi)}$$

and

$$\int e^{X\psi + itX} e^{X_1} \frac{dx}{dX} dX = e^{F_1(\psi + it)} \dots \dots \dots (99)$$

* Very recent work of Neyman and Pearson (1934) has cast doubt on this statement. Our statement in that article implies that the existence of a sufficient statistic is a necessary condition for the existence of a uniformly most powerful test, in the case of one parameter; not that it is a sufficient condition. Fisher seems to imply that the condition is both necessary and sufficient. We have not yet had time to study Neyman and Pearson's work adequately, the matter must, therefore, be regarded as unsettled for the time being.

Hence the characteristic function of X must be

$$M(it) = e^{F_1(\psi + it) - F_1(\psi)} \quad . \quad . \quad . \quad (100)$$

and that of $S(X)$ must be $\{M(it)\}^n$.

This is the characteristic function of $n\phi(T)$, where T is the sufficient statistic. The distribution may then be found by the usual Fourier inversion.

II will not be discussed further here, we turn to III. If the sets of samples for which $\frac{\partial L}{\partial \theta}$ is constant are not the same for all values of θ , there can be no sufficient statistic. But there is a class of cases in which, even for small samples, the information lost may be recovered by means of ancillary statistics in an explicit way. This happens "when samples alike in the information they convey exist for all values of the estimate and occur with the same frequency for corresponding values of the parameter." The nature of the correspondence is best illustrated, as the author shows, by examples. The case of parameters of location is one illustration. If the distribution of a variate x involves a parameter θ , in such a way that the frequency with which x falls in any element dx of its range is a function of $x - \theta$, θ is a parameter of location. If in such a case

$$x - y = \theta - \phi \quad . \quad . \quad . \quad (101)$$

a sample of u values of x will give the same information about θ , as a sample of the corresponding values of y does about ϕ .

Fisher takes the double exponential distribution

$$df = \frac{1}{2}e^{-|x-\theta|}dx \quad . \quad . \quad . \quad (102)$$

for which, when the number of observations in the sample is odd ($n = 2s + 1$), the median is the maximum likelihood estimate of θ . There is no sufficient statistic. The distribution of the median about θ , is given by

$$df = \frac{(2s+1)!}{(s!)^2} (\frac{1}{2}e^{-|u|})^s (1 - \frac{1}{2}e^{-|u|}) \frac{1}{2}e^{-|u|} du \quad . \quad . \quad (103)$$

which tends, as u increases, to the limiting form

$$df = \sqrt{\frac{n}{2\pi}} e^{-\frac{1}{2}nu^2} du \quad . \quad . \quad . \quad (104)$$

The amount of information derivable from a large sample of n tends to equality with n as the size of sample increases. For any size of sample the amount of information can be shown to be

$$\frac{(s+1)(2s+1)}{(s-1)} \left\{ 1 - \frac{(2s)!}{(s!)^{2^{2s-1}}} \right\} \quad . \quad . \quad (105)$$

which tends to $12(\log 2 - \frac{1}{2})$ when $s \rightarrow \infty$.

The loss of information can be shown to be approximately $\frac{1}{4}\left(\sqrt{\frac{s}{\pi}} - 1\right)$, which although tending to zero relatively, increases absolutely without limit as the size of sample increases.

The author next determines the amount of information for samples of a *given configuration*.

If T is the median of a sample of $(2s + 1)$ observations and the observations in increasing order of magnitude are

$$T - a'_s, \dots T - a'_1, T, T + a_1, \dots T + a_s$$

the a 's specify the configuration of the sample.

The amount of information is found to be

$$\frac{1}{A} \left\{ 1 - e^{-a'_1} + \sum_{p=2}^{s+1} (2p-1) e^{2(a'_1 + \dots + a'_{p-1})} (e^{-(2p-1)a'_{p-1}} - e^{-(2p-1)a'_p}) \right. \\ \left. + 1 - e^{-a} + \sum_{p=2}^{s+1} (2p-1) e^{2(a_1 + \dots + a_{p-1})} (e^{-(2p-1)a_{p-1}} - e^{-(2p-1)a_p}) \right\} \quad (106)$$

where $a'_{s+1} = a_{s+1} = \infty$ and A may be obtained from the expression inside the curled brackets by substituting $1/(2p-1)$ for $(2p-1)$ in the factor immediately following the summation signs.

The greatest and least values of this quantity are found to be n^2 and unity, and by an ingenious argument its average value for all configurations is found to be n . All the information is recovered by paying regard to the configuration of the sample. This is, of course, only of theoretical interest since the reduction of the data is entirely sacrificed to its complete interpretation. In the particular case of parameters of location it is important to notice that if $L(\theta - T_1)$ is the likelihood derived from the sample of any value of θ , then the sampling distribution of T for any value of θ , in samples having the same configuration, is

$$df = CL(\theta - T) dT \quad \dots \quad (107)$$

The author also considers in a somewhat similar manner, the recovery of information lost in cases of the simultaneous estimation of location and scaling.

(b) R. A. Fisher also considers the effect of methods of ascertainment upon the estimation of frequencies.

The frequency with which a certain mark or character, such as male sex or albinism, occurs in a population may be estimated in a variety of ways. Which way is appropriate will depend on the manner in which the data have been collected. Fisher here considers the problem of estimating the frequency of a recognizable trait, in the sibships in which it occurs. He distinguishes two methods (i) the proband method and (ii) the sib-method, pointing

out that these terms have long been used in German literature. Fisher does not, however, use them in the same sense as Weinberg, with whose name the terms *Probandenmethode* and *Einfache Geschwistermethode* have long been associated.

Fisher's proband method is, as he points out, only appropriate to the case when we have a random sample of families and when for all families which contain at least one marked individual we have a record of the number marked and unmarked. In this case if s be the number in the family and if $p (= 1 - q)$ the frequency with which the marked character occurs in the population, \bar{r} the mean number of marked individuals observed per family, p will be estimated from

$$\bar{r} = \frac{sp}{1 - q^s} \quad . \quad . \quad . \quad . \quad . \quad (108)$$

This is shown to give the maximum likelihood solution for p , and the variance of the resulting estimate p_m is given by

$$n_s V(p_m) = \frac{pq(1 - q^s)^2}{s(1 - q^s - spq^{s-1})} \quad . \quad . \quad . \quad (109)$$

where n_s is the number of families available.

Fisher's sib-method, which is identical with Weinberg's *Probandenmethode* consists in obtaining the proportion of marked individuals among the sibs of marked persons, such sibs being counted once for each marked person independently ascertained. He obtains the sampling error of the sib-method in its general application to families of the same size, shows that it depends upon an ancillary frequency, the effective probability of ascertainment, shows how the value of the latter quantity may be obtained, and considers certain further refinements of estimation. Before discussing his results, however, it may be well to put on record Weinberg's terminology showing where it differs from Fisher's.

Weinberg's *Einfache Geschwistermethode* (which we might translate *simple sib-method*) is only correct for a random sample of families, i.e. when Fisher's proband-method is correct.

In using it we perform the following processes: (i) We count up the total number of sibs of marked persons in every family, such sibs being counted *once for each marked person in the family*.

(ii) We count up similarly the number of marked sibs of marked persons.

(iii) We divide (ii) by (i).

With Weinberg's *Probandenmethode* on the other hand we proceed as follows:

We start with a random sample of *marked persons* called the *probandi*.

(i) We count up the total number of sibs of the *probandi*.

(ii) We count up similarly the total number of marked sibs of *probandi*.

(iii) We divide (ii) by (i).

The difference between the *Einfache Geschwistermethode* and the *Probandenmethode* may be illustrated as follows: Supposing we had a family of 9 containing 3 marked people. If the family was one of a random sample of families it would contribute 3×8 towards (i) and 3×2 towards (ii). If, however, the family had been ascertained through *only one* of its members, who was one of a random sample of marked persons, it would contribute 1×8 towards (i) and 1×2 towards (ii). Weinberg has given a number of examples showing how the *Einfache Geschwistermethode* goes wrong in cases where the *Probandenmethode* is appropriate. (See for instance (F 5) p. 436.)

If we have a complete set of families occurring with their expected frequencies and if *all marked persons are ascertained independently* the *Probandenmethode* gives the same answer as the *Einfache Geschwistermethode*. To illustrate this we consider Fisher's example. If albinism is a simple Mendelian recessive, its frequency among the children of heterozygotes will be $\frac{1}{4}$. In this case we should expect families of 5 to contain 1, 2, 3, 4, 5 albinos with the following frequencies 405, 270, 90, 15, 1. We then have for the *Einfache Geschwistermethode*

Number of Albinos.	Number of Families.	Number of Sibs of Albinos.	Number of Marked Sibs of Albinos.
1	405	$1 \times 4 \times 405 = 1,620$	
2	270	$2 \times 4 \times 270 = 2,160$	$2 \times 1 \times 270 = 540$
3	90	$3 \times 4 \times 90 = 1,080$	$3 \times 2 \times 90 = 540$
4	15	$4 \times 4 \times 15 = 240$	$4 \times 3 \times 15 = 180$
5	1	$5 \times 4 \times 1 = 20$	$5 \times 4 \times 1 = 20$
		5,120	1,280

and the frequency is correctly estimated as $\frac{1}{4}$. If *all marked persons are ascertained independently* the first two columns give us the number of *probandi* and the *Probandenmethode* gives us the same answer.

Thus, summarizing, we find that Weinberg's *Einfache Geschwistermethode* is only correct for a random sample of families, *i.e.* when Fisher's proband method is correct. Weinberg does not use Fisher's proband method. Weinberg's *Probandenmethode* is the same as Fisher's sib-method and is always correct, even when ascertainment is incomplete.

In the general case of incomplete ascertainment Fisher finds that if p' is the probability of an individual being brought into the record, irrespective of the composition of the family to which he belongs, if p be the frequency it is desired to estimate, if n_{rt} stands for the number of families observed in the class which contains r marked individuals of which t have been ascertained independently, then the appropriate estimate of p is given by

$$p_s = \frac{S\{t(r-1)n_{rt}\}}{(s-1)\bar{S}(tn_{rt})} \quad . \quad . \quad . \quad (110)$$

the summation being over all classes and that

$$V(p_s) = \frac{p(1-p)\{1+p'+pp'(s-3)\}}{n(s-1)} \quad . \quad . \quad (111)$$

while p' is to be estimated from

$$p' = \frac{S\{t(t-1)n_{rt}\}}{S\{t(r-1)n_{rt}\}} \quad . \quad . \quad . \quad (112)$$

These results are conveniently summarized by writing

$$\left. \begin{aligned} T &= S\{t(t-1)n_{rt}\} \\ R &= S\{t(r-1)n_{rt}\} \\ S &= S\{t(s-1)n_{rt}\} \end{aligned} \right\} \quad . \quad . \quad . \quad (113)$$

giving the estimates

$$p_s = \frac{R}{\bar{S}} \quad p' = \frac{T}{\bar{R}} \quad . \quad . \quad . \quad (114)$$

with estimated variance.

$$V(p_s) = \frac{(S-R)}{\bar{S}^4} \{RS + ST + RT(s-3)\} \quad . \quad . \quad (115)$$

a form convenient for numerical computation.

Bartlett (A 6) has written an interesting paper on methods for testing whether a set of variances differ significantly. He shows that if $A, B, C, D \dots$ are a number of independent sums of squares of a normal deviate with $n_1, n_2, n_3, n_4 \dots$ degrees of freedom (so that they can be expressed respectively as the sums of n_1, n_2, n_3, n_4 squares of independent quantities having the same variance) then the quantities $\frac{B}{A}, \frac{C}{A+B}, \frac{D}{A+B+C}, \dots$ are independently distributed.

This may be shown from geometrical considerations or a quite easy algebraical treatment. It follows that the comparison between the estimates of variance $\frac{A}{n_1}, \frac{B}{n_2}, \frac{C}{n_3}, \frac{D}{n_4} \dots$ can be replaced by independent comparisons between the above ratios, the comparison being made in each case by the "z" test. The probability levels

obtained from each test, may then be combined into a single test by using the fact that $(-2 \log p)$ is distributed as χ^2 with 2 degrees of freedom, in the manner suggested by Fisher (F 3).

The author then shows that this principle may be extended to two variates and leads to a joint test of significance for the difference between k regression coefficients calculated from k samples, and of the k residual variances about the k sample regression lines.

VI. *Analysis of Variance.*

By W. G. COCHRAN.

A subject which attracted considerable attention in 1934 was the use of the analysis of covariance, first introduced by Fisher in the fourth edition of his book *Statistical Methods for Research Workers*. Of the eight papers in this section which have come to our notice during 1934, four contain references to this topic, two on the theoretical side and two illustrating practical applications; and several papers which are not reviewed below also exhibited the use of this new and powerful weapon.

Fisher and Yates (A 49) give the details of their method of enumerating the 6×6 Latin Squares, a task which had not previously been correctly performed. This is done by first finding the number of *reduced squares*, a *reduced square* being a square in which the first row and column have their letters in the order *ABCDEF*. Since each reduced square generates $6! \cdot 5!$ distinct squares by permuting all rows except the first and all columns, the number of reduced squares has only to be multiplied by 86,400 to give the total number of 6×6 Latin squares. The enumeration of the number of reduced squares without excessive labour was carried out by making use of the properties of a type of transformation called *intramutation*, which consists of permuting the letters other than *A* in a reduced square and then rearranging the rows and columns so as to give another reduced square. The enumeration was carried out in three stages: (i) the exhaustive enumeration of all possible types of leading diagonal, (ii) the determination of the number of distinct diagonals which can be generated by intramutation from each typical diagonal, (iii) the enumeration by trial of all possible reduced squares having the given typical diagonals. The same number of reduced squares will be derivable from all diagonals which can be generated by intramutation from the typical diagonal under consideration, so that these operations enable the number of reduced squares to be obtained. The number is 9,408, arranged in 111 intramutation sets.

In presenting the 812,851,200 6×6 Latin squares, a more

general type of transformation was used, all the members of a transformation set being derivable from the typical member shown by the permutation of all rows, all columns and all letters. This enabled the presentation to be made by means of 17 examples, involving only 12 distinct types of square. This presentation, together with a method of picking a square at random from the set of all squares, had already been given by one of the authors (G 5).

The problem of the enumeration of 6×6 Latin squares was first discussed by Euler (G 3) in 1782, while he was attempting to show that no 6×6 Græco-Latin square exists. It is easy to verify from Fisher and Yates's enumeration that this is so, but, remarkably enough, this is the first rigorous proof of the fact which has appeared.

Bartlett (A 7) gives a review in vector notation of all cases of the analysis of variance of one dependent variate. A sample of n observations of a variate x is written as the vector

$$S = (x^{(1)} \dots x^{(n)}) \dots \dots \dots (116)$$

where

$$S^2 = SS' = \Sigma x^2 \dots \dots \dots (117)$$

The operation of fitting a linear regression equation may be represented by regarding S as being related to a matrix Z of vectors Z_1, \dots, Z_p , by the equation

$$S = BZ + V$$

where B is a single row matrix of coefficients b_i ($i = 1, \dots, p$). In geometric terms, $BZ = U$ say, is the component of S in the "plane" of Z_1, \dots, Z_p , and V the residual component. The most general case is obtained by writing $U = X + Y$, where X is the component in the restricted "plane" Z_1, \dots, Z_q ($q \leq p$) and is to be eliminated, and Y is the remaining component. Thus

$$S = X + Y + V \dots \dots \dots (118)$$

and it follows at once that

$$S^2 = X^2 + Y^2 + V^2 \dots \dots \dots (119)$$

Up to this point the paper has been concerned with establishing the *algebraic* independence of the components in an analysis. Bartlett next proves the necessary and sufficient vector condition for the normal law, which is that the chance of a vector S depends only on its length and not on its direction. It follows at once that algebraic independence implies independence of frequency distributions in these cases. As an example of the interpretation of equation (119) Bartlett derives the exact test of significance for the treatment sum of squares in an analysis of covariance.

The results are then extended to the case of two or more correlated variates, in which S becomes a matrix representing the set of vectors S_1, S_2, \dots . The general equation remains in the form (118) but instead of (119) we have

$$SS' = XX' + YY' + VV' \quad . \quad . \quad . \quad (120)$$

If, for example, there were two variates x and y , (120) stands for three equations, representing respectively the analysis of variance of x , that of the covariance xy and that of the variance of y . The question of a single test of significance of Y , in cases where it may be of interest, is considered, the function

$$\Lambda = V^2/(Y + V)^2 \quad . \quad . \quad . \quad (121)$$

being suggested.

Papers by Cochran (A 24) and Irwin (A 63) deal essentially with equation (119) above expressed in the ordinary algebraic form, for the particular cases of randomized blocks and the Latin square, both providing in these cases proofs of the mathematical theory underlying the analysis of variance. It is a well-known result that in an analysis of variance any set of degrees of freedom may be expressed as independent single degrees of freedom in an infinite number of ways. Irwin finds for the randomized blocks design a simple set of linear functions of the plot yields which are independent and make up the block, treatment and error degrees of freedom. For the Latin square there is in the general case no obvious simple set of single degrees of freedom for error, but one can be found easily when the size of the square is a prime, and Irwin obtains this for the cases $n = 3$ and $n = 5$. The second part of Cochran's paper considers equation (119), also from the algebraic point of view, in the case of the analysis of covariance, though the exact test of significance for the treatment sum of squares is not reached.

The question of the analysis of variance of two-way classifications with unequal numbers of objects in the different classes is of considerable practical importance, and papers on this subject by Brandt (G 2) and Yates (A 130) were reviewed previously (G 1). Where it is desired to test both main effects and their interaction against the variation within classes, a rigorous test is in general only possible by the rather laborious method of fitting constants. Snedecor (A 105) has suggested a method which is easier to apply and gives in most cases results practically equivalent to those obtained by fitting constants. If n_{rs} is the number of objects in the r throw and s th column, and $n_r = \sum_s n_{rs}$, $n_s = \sum_r n_{rs}$ and $n = \sum_{rs} n_{rs}$ are the totals in the r th row and s th column

and the general total respectively, he replaces n_{rs} by an expected number $\frac{n_r \cdot n_s}{n}$. The numbers of objects in the classes are still unequal, but have now the property of proportionality. As a result of this, the main effects may be obtained by a weighted sum of squares of totals and the interaction by subtraction. Further, in this case the additive property of sums of squares holds, so that the test for main effects is the same whether the interactions are assumed to exist or not. There are cases in which the process of replacing the actual numbers in the sub-classes by expected numbers has some theoretical justification, but in general the adjustment will be a numerical convenience and stand or fall by the closeness with which the results agree with those given by the method of fitting constants. An investigation on this point was made by Snedecor and Cox (A 106), who found good agreement except in one case, and in that the discrepancy between observed and expected numbers, as measured by the χ^2 test, was highly significant.

A paper by Yates (A 132), describes the design, conduct and statistical analysis of a feeding experiment of the factorial type on pigs and provides a good example of how the introduction of analysis of covariance has enabled the design of such an experiment to be improved.

Sterne (A 108) gives a proof of the t distribution for the ratio of the deviation of a fitted constant from its true value to the estimated residual standard deviation in a least squares solution. He claims to have established the t distribution under more general conditions than those assumed in the proof by Fisher (G 4), but this does not appear to the reviewer to be the case.

VII. *Other Investigations.*

By W. L. STEVENS and J. O. IRWIN.

There are a number of statistics which characterize the "average" of a set of data. Of these the commonest are the arithmetic mean and the median. In cases where these are both estimates of the same parameter, it would be natural to prefer the more efficient, *i.e.* the one with the smaller variance. In general, there will be no parameter of which the mean and the median are both estimates, but Pollard (A 91) suggests that the same criterion should still be employed to decide which of these most usefully represents the "average" of the data.

Using large sample theory he investigates the relative stability (*i.e.* invariance) of the mean and median for two types of frequency distribution ;

(i) The distribution made from the sum of two normal distributions.

(ii) The symmetrical distribution made from the sum of three normal distributions.

In the former case, where the area of the component normal curves are equal, it is found that the median is more stable for high and low values of the ratio of the standard deviations, while the mean is more stable in the intermediate range.

To avoid the limitations of large sample theory, Pollard makes a different approach to small samples. When the form of the original distribution has been postulated, it is possible to find the percentile points of the distribution of the median, without assuming normality. The percentile points of the distribution of the mean are found, however, on the assumption that this distribution is normal even for small samples. A comparison of the ranges between the same percentile points (and in particular of the interquartile ranges) will then decide whether the mean or the median is more stable.

Treloar and Wilder (A 114) have undertaken an investigation into "the adequacy of Student's criterion." In the problem of testing whether the mean \bar{x} of a sample from a normal population differs significantly from a hypothetical mean m , when the standard deviation is estimated from the sample itself, the regions of significance are bounded by lines on which $\frac{|\bar{x} - m|}{s}$ is constant. On the other hand if the standard deviation is known *a priori* the regions of significance are bounded by lines on which $\frac{|\bar{x} - m|}{\sigma}$ is constant.

The authors note that these regions are by no means identical, and consider that those samples which are found significant on the *t*-test but not on the latter test have been "irrationally selected."

Those who think that it is reasonable that the question of significance of the mean should be differently answered according to whether we have or have not prior knowledge of the standard deviation, will object to the suggestion in the title of the paper that the discrepancy is an indication of inadequacy of the *t*-test. The numerical evaluation of the discrepancy is really of interest in bringing to light the nature of the inadequacy of small samples.

Hansmann (A 60) considers the system of symmetrical frequency curves which satisfy the differential equation

$$\frac{1}{y} \frac{dy}{dx} = \frac{-x}{c_0 + c_2 x^2 + c_4 x^4} \quad \cdot \quad \cdot \quad \cdot \quad (122)$$

He distinguishes six main and fourteen transition types according to the relations between the constants. The method of moments

is used for fitting, the curves being obvious generalizations of the usual Pearsonian curves, and the constants are expressed in terms of

$$\beta_2 = \frac{\mu_4}{\mu_2^2} \quad \beta_4 = \frac{\mu_6}{\mu_2^3} \quad \beta_6 = \frac{\mu_8}{\mu_2^4}.$$

Great ingenuity is shown in distinguishing the various types according to the relations between the β 's.

A somewhat better fit is given by this system than by Pearson's Type VII to the Bessel function distribution of the first product moment in sampling from a normal population with no correlation, but the difference seems solely due to the employment of an additional parameter. The same seems to be true in the distribution of 300 observations of the right ascension of a star. Another example given is the distribution of 1,000 shots fired from a battery gun, but the values of β_2 , β_4 , β_6 observed are inconsistent with the postulated system of curves. The author has tried a number of curves with the correct values of β_2 , β_4 and varying values of β_6 . The changes in shape of the resulting curves are remarkable, and suggest the inadvisability of adopting a method of fitting which needs the use of high moments with large sampling errors.

David (A 31) gives a table of $P_{\lambda_n} = 1 - P(\chi^2, 2n)$ where n is the number of degrees of freedom, which is likely to be useful in combining the results of separate significance tests. P_{λ_n} is tabulated against the argument $-\log_{10}\lambda_n = \frac{1}{2}\chi^2 \log_{10}e$ to four decimal places at interval 0.125 for $n = 2$ (1) 6 and of 0.25 for $n = 7$ (1) 30 over the whole range of values of P_{λ_n} between 0 and 1.

Davies (A 32) considers approximations to the sum of any number of terms of a hypergeometric series $F(\alpha, \beta, \gamma, x)$, in which x is not unity.

Most of the approximations considered are obtained by replacing the histogram representing the series by a continuous curve. In one form of approximation the continuous curve is taken to be a curve which has the same ratio of slope to ordinate at the boundaries of the frequency groups as has the histogram itself. In another, the previous form of approximation is used for the terms of the series $F(\alpha, \beta, \gamma, 1)$ the results obtained being subsequently multiplied by the appropriate power of x .

In either case the approximate curve is of the form $ce^{-\rho z}P(z)$, where P is a Pearsonian curve. Approximations to the probability integral of this function are then obtained by various forms of expansion about its mode, or about the "stump" if it is the "tail" which is a matter of interest. For regions outside $\pm 2.5\sigma$ from the mode certain of the approximations to the sum of the corresponding terms of the hypergeometric series, depending on the repeated ratios

of the successive terms are found to give good results. Where these fail the fitting of the "tail" of a Type III curve is sometimes found useful.

Sewall Wright gives a detailed and practical exposition of path coefficients, which provide a method for expressing quantitatively the relative importance of the components of a hypothetical scheme of causal relations. As the author emphasizes, correlation analysis is never sufficient in itself to prove causality. The scheme of causality is devised by a qualitative examination of the specific problem, and provided the scheme is adequate, correlation analysis and, in particular, the method of path coefficients enable the importance of the various paths of the causal network to be measured.

When the assumed causal network between the different variates has been set down in a diagram, it is possible to express the expected deviation of any dependent variate as a linear function of the deviations of the variates immediately affecting it,

$$(V_0 - \bar{V}_0) = \sum_{r=1}^n c_{0r}(V_r - \bar{V}_r) \quad . \quad . \quad . \quad (123)$$

When these deviations are expressed as fractions of their own standard deviation, the equations take the form

$$X_0 = \sum_{r=1}^n P_{0r}X_r \quad . \quad . \quad . \quad . \quad (124)$$

and the coefficients P_{0r} are called path coefficients. Consequently the correlation between any two variables in the network can be expressed as the sum of products of path coefficients and one correlation coefficient. Each product is derived from one of the paths causally connecting the two variables and may, therefore, contain the correlation of two variables which are considered as ultimately independent.

One can, therefore, write down a series of equations. If the path coefficients are known theoretically it is possible to evaluate any desired correlations, and, conversely if correlation coefficients have been determined empirically, the equations may be solved to give the path coefficients.

Even when other methods of solution are available, it seems that the method of path coefficients provides the best approach, because

(i) One is forced to state clearly (and in fact, diagrammatically) the assumed paths of causation and, therefore, to make these consistent with prior qualitative knowledge.

(ii) One can then write down systematically, and almost mechan-

ically, the system of equations, and incidentally detect at once if the data are adequate for solution.

The author applies the method to an extraordinarily wide range of practical problems, the effects of inbreeding, the dependence of birth-weight of guinea-pigs on size of litter, the factors controlling the transpiration of plants, the relative importance of environment and heredity, the analysis of size-factors in measurements of the skeleton, correlation between the production of hog and corn in the U.S.A., and elasticities of supply and demand.

Liebmann Hersch (A 62) gives methods for the systematic analysis of periodic data. In order to describe quantitatively the data of one complete cycle, he proposes a number of indices:—

(i) The mean $= v_m$.

(ii) The amplitude $= \alpha$, the amplitude relative to the mean $= \frac{\alpha}{v_m}$,

and relative to the standard deviation $= \frac{\alpha}{\sigma}$.

(iii) The average deviation from the mean :

(a) the arithmetic mean of the deviations $= \bar{d}_m$.

(b) the standard deviation $= \sqrt{\text{mean square deviation}}$
 $= \sigma$.

(c) $\frac{\bar{d}_m}{v_m}$ and $\frac{\sigma}{v_m}$.

(iv) Successive differences.

(a) arithmetic mean of successive differences $= e_m$.

(b) root mean square of successive differences $= \zeta$.

(c) $\frac{e_m}{v_m}$ and $\frac{\zeta}{v_m}$.

(v) Concentration. Indices k_n and c_n of concentration and v_n of uniformity (“*nivellement*”).

(vi) Abruptness. Indices p_n of abruptness and g_n of gradualness.

(vii) Indices of symmetry of

(a) deviations of the mean, s_d .

(b) successive differences, s_e .

(c) central differences, s_η .

Consider the series—

$$A = 16, 4, 10, 10, 10, 10, 10, 10, 10, 10, 10, 10.$$

$$B = 11, 11, 11, 11, 11, 11, 9, 9, 9, 9, 9, 9.$$

The respective means and arithmetic means of deviations from the mean are the same, but clearly the series differ in that the variation of the former is concentrated in the first two terms, and in the latter

the variation is spread uniformly through the series. The standard deviation of the former is $\sqrt{6}$, of the latter 1. This qualitative difference finds expression in the ratio $\frac{\sigma}{d_m}$. It may be proved that the upper and lower limits of this ratio are $\sqrt{\frac{n}{2}}$ and 1, where n is the number of terms in the series, and therefore it is suggested that

$$c_n = \frac{\frac{\sigma}{d_m} - 1}{\sqrt{\frac{n}{2}} - 1} \quad (125)$$

is an absolute measure of concentration.

Some series fluctuate violently; others vary smoothly. This is expressed in the successive differences $(v_2 - v_1)$, $(v_3 - v_2)$, etc., and a suitable index is $\frac{\zeta}{e_m} = \frac{\sqrt{\text{mean square successive difference}}}{\text{arithmetic mean of successive differences}}$. This index also (for monomodal series) lies between $\sqrt{\frac{n}{2}}$ and 1, and hence the absolute index of abruptness is

$$p_n = \frac{\frac{\zeta}{e_m} - 1}{\sqrt{\frac{n}{2}} - 1} \quad . \quad . \quad . \quad . \quad (126)$$

The general index of symmetry is

$$s = \frac{2\sum xy}{\sum x^2 + \sum y^2} \quad . \quad . \quad . \quad . \quad (127)$$

where x and y are pairs of quantities "equidistant" from the centre of symmetry. These may be deviations from the mean, successive differences or deviations from the central value. The index must lie between $+1$ (complete positive symmetry) and -1 (complete negative symmetry) and is, therefore, already an "absolute" index. The value will, of course, depend on the point chosen as the centre of symmetry, but it is proposed that the index of the series be defined as the maximum value attained for different centres of symmetry.

In cases where data can be fitted by curves of reasonably simple form, these indices appear to present no advantages, particularly as nothing is known about their standard errors. But they are of value in comparing data to which no simple curve can be fitted, as in the example in which the author compares the daily variations

of the production of gas at Geneva in winter weeks and summer weeks.

Haldane in 1930 investigated the rate of approach to homozygosis in a line of selfed autotetraploids. Bartlett and Haldane (A 8) have now extended this investigation to the case of successive brother sister mating.

The method is interesting. It consists in setting up a system of finite difference equations in terms of the frequencies of the various types of matings. The roots of such a system of equations can be expressed as the sum of the n th terms of a number of geometrical progressions. After a dozen or so generations all the terms in the sum except the largest are negligible, and thereafter a simple general formula expresses the amount of residual heterozygosis. The results show that the approach to homozygosis is very slow. Thirty-one generations from a cross between two homozygotes are needed to reduce the proportion of heterozygosis to one-tenth.

Von Schelling provides an interesting paper on curves and measures of concentration.

It is well known that if we have a population arranged in ascending order of magnitude of a certain character x , then if s_r be the sum of the values of the character in the first r individuals and if s_r be plotted against r we obtain the curve of concentration. The conception is useful in the study of the distribution of incomes.

If all values of the character are equal the curve of concentration is a straight line and forms a right-angled triangle with the axis of reference. When all values of the character are not equal we get a curve convex to the base. The area between the curve and the hypotenuse of the triangle is known as the area of concentration, and it may be shown that the ratio of this area to the total area of the triangle is $\Delta/2A$, where Δ is the mean of all possible differences taken positively and A is the arithmetic mean.

This ratio, often called the measure of concentration, may be expressed analytically in terms of the frequency distribution. In the case of incomes it will be zero when all incomes are equal and unity when one person possesses everything.

Schelling's contribution consists in introducing a function $f(x)$ defined by

$$\frac{\bar{x}}{x} = 1 + f(x) \quad . \quad . \quad . \quad . \quad (128)$$

where \bar{x} is the mean of values of the character (let us say incomes) greater than x .

When Pareto's law of distribution

$$\phi(x) = C/x^{n+1} \quad . \quad . \quad . \quad . \quad (129)$$

holds $f(x)$ is shown to be independent of x , for a distribution which is the sum of several Pareto functions $f(x)$ increases monotonically with x while by putting

$$f(x) = 1/(n-1)x^k \quad 0 < k < 1 \quad . \quad . \quad . \quad (130)$$

a distribution can be found for which $f(x)$ decreases monotonically, a state of affairs apparently somewhat nearer to the truth for the distribution of incomes shown by some German and Danish statistics.

Pareto's distribution is shown to be the only continuous distribution for which the measure of concentration is independent of the lowest income occurring (c_1). In this case, if ζ is the measure of concentration we have, provided $n > 1$

$$f(c_1) = \frac{x}{c_1} - 1 = \frac{1}{n-1} \quad . \quad . \quad . \quad (131)$$

$$\zeta = \frac{\frac{\bar{x}}{c_1} - 1}{\frac{\bar{x}}{c_1} + 1} = \frac{1}{2n-1} \quad . \quad . \quad . \quad (132)$$

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ON A PARALLELISM BETWEEN DIFFERENTIAL COEFFICIENTS AND REGRESSION COEFFICIENTS.

By G. UDNY YULE, F.R.S.

THE simplest relation between regressions of any order and regressions of the next higher order is that of the form given on p. 190 of my paper "On the Theory of Correlation," etc., in *Proc. R.S.*, 1907: A, 79, viz.—

$$b_{12k} = b_{123k} + b_{32k} b_{132k} \quad . \quad . \quad . \quad (1)$$

where k denotes any collection of variables other than 1, 2, and 3.

If $u = f(xy)$, we have for the relation between total derivatives and partial derivatives in the ordinary notation :

$$\frac{du}{dx} = \frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} \frac{dy}{dx} \quad (2)$$

But this notation is not only lacking in generality, it is also hopelessly ambiguous. Obviously, the notation used for regressions may at once be applied to derivatives, and the notation thus rendered at once both general and precise. Let us write x_1 for u ; x_2, x_3 for x and y , and k if we please for any collection of otherwise unspecified variables. Let dx_1/dx_2 be denoted by d_{12} ; the partial derivative $\frac{\partial u}{\partial x}$ if only x_3 be kept constant by d_{123} , and so forth. Then

(2) may be written, in its general form

$$d_{12k} = d_{123k} + d_{32k} d_{132k} \quad . \quad . \quad . \quad (3)$$

This is identical with equation (1) for regressions: regressions and derivatives of different orders are related by equations of precisely the same form, and this renders the term *partial* regressions, suggested by Professor Karl Pearson for regressions of all orders higher than zero, peculiarly appropriate.

But there are fundamental differences. For derivatives we necessarily have

$$d_{12k} d_{21k} = 1 \quad . \quad . \quad . \quad (4)$$

for regressions

$$b_{12k} b_{21k} = r_{12k}^2 \quad . \quad . \quad . \quad (5)$$

where r_{12k}^2 may range between 0 and 1, and in practical examples is usually considerably less than unity. More generally, for differential coefficients of the same order

$$d_{12k} d_{23k} = d_{13k} \quad . \quad . \quad . \quad (6)$$

whereas for regressions no such relation holds good between $b_{12\lambda}$, $b_{23\lambda}$, $b_{13\lambda}$ save exceptionally. In consequence of these special relations for derivatives, certain expressions in equations between regressions become indeterminate: *e.g.* in the familiar equation (13) * of the paper cited the right-hand side takes the form 0/0.

* In the denominator of this equation read 2 for 1 in the primary subscripts.

REPORT OF THE COUNCIL.

For the FINANCIAL YEAR ended December 31, 1935, and for the SESSIONAL YEAR ending June 16, 1936, presented at the ONE HUNDRED AND SECOND ANNUAL GENERAL MEETING of the ROYAL STATISTICAL SOCIETY, held in the Hall of the Royal Society of Arts, John Street, Adelphi, W.C.2, on June 16, 1936.

THE Council have the honour to submit their One Hundred and Second Annual Report.

The roll of Ordinary Fellows on December 31 last, as compared with the average of the previous ten years, was as follows :—

Particulars.	1935.	Average of the previous Ten Years.
Number of Fellows at end of previous year ...	1037	1049
Number lost by death, withdrawal, or default ...	53	58
New Fellows elected	67	61
Numbers of Fellows on December 31	1051	1053

Since December 31 last, 29 new Fellows have been elected or restored to the list, and the Society has lost 42 by death, resignation, or default, so that the number on the list, excluding 17 Honorary Fellows, on June 16, 1936, is 1,038 against 1,031 a year ago.

Since June, 1935, the Society has lost by death the under-mentioned Ordinary Fellows :—

	Date of Election.
<i>d</i> *Andersson, Thor E. E., Ph.D.	1907
*Beale, Sir John Field, K.B.E.	1917
*Bentley, Richard	1884
<i>c</i> *Blackett, Sir Basil P., K.C.B., K.C.S.I.	1920
Elbourne, E. T., A.M.I.Mech.E.	1927
Gardner, Thomas	1935
Hogg, Margaret H.	1922
<i>c d p</i> Hooper, Wynnard	1878
<i>d p</i> Hutchins, Bessie Leigh	1902
*Stock, Edward J., A.I.A.	1906
Waldron, John William	1920
*Walsh, Correa M., Ph.D.	1904
<i>c d p</i> Watson, Sir Alfred W., K.C.B., F.I.A.	1902
*White, Rev. George C., M.A.	1887
Williams, Leyshon Richard	1928

* Life Fellow. *c* Served on Council. *p* Read a Paper or Papers.
d Donor to the Library.

This list includes seven Life Fellows and a number of names well known in the Society and outside it. The Council have especially to mourn the loss of Sir Alfred Watson, who was a valued member of their own body until his failing health forbade his undertaking any duties in addition to his own work, to which he devoted all his strength up to the date of his sudden death, in May. Sir Alfred, nevertheless, continued to take a sympathetic interest in the Society's affairs and followed their Proceedings in the *Journal*. It will be remembered that he himself read a paper of outstanding importance in 1927—"National Health Insurance: A Statistical Review." His service on the Council dates from 1912, and continued, with intervals of retirement, until 1932. An obituary notice will be found in Part III of the *Journal* for the current year.

The tragic death of Sir Basil Blackett in a motor accident last year was felt by the Council as the loss of a former colleague whom they held in affection and of an expert whose career of usefulness had been cut short at an early age. Sir Basil was a member of Council from 1929 to 1933, and a Vice-President in the session 1932–33. He never read a paper before the Society, but frequently contributed to discussions on financial subjects at the meetings.

Mr. Wynnard Hooper had been a Fellow for 57 years, and had served on the Council in the past. Obituary notices of Sir Basil Blackett and Mr. Hooper were published in Part IV of the *Journal*, 1935.

Miss Margaret Hogg, who was formerly Professor Bowley's assistant in the Statistical Department of the London School of Economics and collaborated with him in "Has Poverty Diminished?" had been for some years engaged in statistical research at the Russell Sage Foundation in New York, and her monograph on "The Incidence of Work Shortage," published by the Foundation in 1932, will be recalled as an excellent utilization of the method of sampling. Her death, at a comparatively early age, is greatly regretted.

Mr. Edward T. Elbourne's election in 1927 was a re-election, after an interval of four years. His Fellowship covered fourteen years in all.

The name of Dr. Correa Walsh, an American Fellow, will perhaps recall to readers of the *Journal* his friendly controversies with Professor Edgeworth.

Dr. Thor Andersson was the originator and editor of, and the chief contributor to, the *Nordisk Statistisk Tidskrift*, a statistical and

economic periodical concerned with the Scandinavian countries, which ceased with his death. He had been a Fellow for twenty-eight years, and frequently visited this country and the Society.

Since June, 1935, the following have been elected Fellows of the Society :—

Abrams, Mark Alexander, Ph.D.	Keskar, Y. D.
Adams, Ronald Stanley.	Lopez-Romero, Prof. Antonio.
Aly, Ali Abdul Wahed.	MacIntosh, Duncan William.
Auten, Richard Kenneth.	Meek, David Burnett, C.I.E., O.B.E.
Babington-Smith, Bernard.	Mehta, Nowzer.
Bird, Leslie E.	Mitra, Kalidas.
Burn, John Lancelot.	Morton, Desmond John Falkiner.
Chambers, E. G.	Mukherji, A. C.
Cunningham, Harry, F.S.A.A.	Nanavati, Romesh Chandra Motilal.
Dalal, T. B., B.A.	Parikh, S. H., B.Com.
Dawar, Lajpat Raj, M.A.	Picknett, Bernard Frederick.
Eitzman, Israel Wilfrid.	Ponsonby, Gilbert Jocelyn.
Elbourne, Kenneth Bell.	Pumphrey, Roland.
El-Far, Muhammad.	Razack, Hector Muhamed Abdul.
Forty, Arthur Alan, M.R.C.S., L.R.C.P.	Robinson, Herbert William.
Gates, Terence Horatio.	Rose, Douglas George, B.Sc.
Gearing, Harold William George, B.Sc.	Rowson, Robert Bryan.
Grant, Alexander Thomas Kingdom.	Sadgrove, Walter Arthur.
Guha, Amahendru, M.A.	Scofield, Lionel Percy John Atkins.
Henry, Fred, LL.D.	Sowerbutts, Geoffrey Lloyd.
Home, James Bertram.	Sukhatme, Pandurang Vas.
Hoontrakool, Siri.	Thomas, Ragland.
Hopkins, Albert Hamilton.	Tiruchelvam, Raphael Lawrence.
Hyttén, Prof. Torleiv.	Trubridge, George Fred Parkhurst, M.Sc., Ph.D.
Jayawardena, Neville Ubesinghe.	Waddell, Robert Ross.
Kennet of the dene, The Rt. Hon. Lord.	Wadsworth, John Edwin.
	Wilson, Roland.

Representatives of Corporate Bodies :

Caustin, Harold E.,	<i>representing</i> The Oxford Institute of Statistics.
Davies, William T.	<i>representing</i> The Imperial Tobacco Company, Limited.
Sharman, Charles F.	
Kantorowitsch, Miron,	<i>representing</i> The Jewish Health Organization.
Sheasby, Basil,	<i>representing</i> The Society of Incorporated Accountants and Auditors.
Lusted, Ernest Jack,	<i>representing</i> Messrs. Peek, Frean and Company, Limited.

During the session 1935–36 60 candidates were elected or restored to the list, compared with 62 in the session 1934–35 and 72 in the session 1933–34. The position at the end of each of the last 25 calendar years is shown in the Table on p. 784.

The Society's financial position is shown in the appendices

(A i and A ii), which give the receipts and payments during 1935, and balance sheet at December 31, 1935, together with those of the previous year. The excess of payments over receipts of £203 *1s.* 7*d.* is entirely attributable to the expenditure incurred in connexion with the Industrial and Agricultural Research Section. It will, however, be seen that the income from the sale of the Supplement, the greater part of which is paid as associate subscriptions to the Section, was more than double that of 1934, confirming the expectation, before expressed, that the Section will in time prove a financial as well as a scientific asset to the Society.

The Ordinary Meetings have been held in each month of the Session, and the papers read before the Society were as follows :—

1935.

I.—November 19th ... CONNOR, L. R., M.Sc. Urban Housing in England and Wales.

II.—December 17th ... ROWSON, S., M.Sc. A Statistical Survey of the Cinema Industry in Great Britain in 1934.

1936.

III.—January 21st ... HILL, A. BRADFORD, D.Sc. The Recent Trend in England and Wales of Mortality from Phthisis at Young Adult Ages.

IV.—February 18th ... WHITE, G. RONALD, M.A. Some Statistical Aspects of Future Trading on a Commodity Exchange.

V.—March 17th ... GIBBON, SIR GWILYM, C.B., C.B.E., D.Sc. The Expenditure and Revenue of Local Authorities.

VI.—April 21st ... KEYNES, J. M. William Stanley Jevons, 1835–1882: a centenary allocution on his life and work as economist and statistician.

VII.—May 19th ... STAMP, SIR JOSIAH, G.C.B., (I.B.E.), D.Sc. The Influence of the Price Level on the Higher Incomes.

VIII.—June 16th ... GREENWOOD, PROFESSOR MAJOR, D.Sc., F.R.C.P., F.R.S. English Death-Rates, Past, Present and Future.

At the meetings of the Industrial and Agricultural Research Section the following papers were read and discussed :—

1935.

I.—November 28th ... JENNETT, W. J., and DUDDING, B. P. The Application of Statistical Principles to an Industrial Problem. (Communication from the Research Laboratories of the General Electric Company, Limited.)

1936.

- II.—January 30th ... [This Meeting was devoted to a lecture by Dr. L. J. COMBIE, M.A., F.R.A.S., on Recent Developments in Mechanical Computing, a summary of which appears in the Supplement.]
- III.—March 26th ... GOSSET, W. S. Co-operation in Large-Scale Experiments.
- IV.—May 28th ... GOULD, C. E., and HAMPTON, W. M., Ph.D., B.Sc. Statistical Methods Applied to the Manufacture of Spectacle Glasses.

During the session 1935–36, the Study Group, under the Chairmanship of Dr. J. O. Irwin, held eight meetings, and the papers read and discussed were as follows :—

1935.

- November 12th ... COCHRAN, W. G. Statistical Analysis of Field Counts of Diseased Plants.
- December 10th ... GEORGE, R. F. Sample Investigation of the 1931 Population Census, with reference to Earners and Non-earners.

1936.

- January 14th ... DOUGLAS, IRIS. A Survey of Distribution as shown in the Industry Tables of the 1931 Census.
- February 11th ... SPRAY, C. H. A Brief Survey of Merchant Shipping Statistics.
- March 10th ... POTTER, D. C. H. Statistics available from Life Assurance Companies.
- April 7th ... BROSTER, E. J. The Demand for Travel in Great Britain.
- May 12th ... BARTLETT, M. S. Statistical Technique in Certain Points of Field Count.
- June 9th ... (Annual General Meeting.)

By the death of H.M. King George, which overshadowed the life of the nation in January, the Society lost its honoured Patron and sometime Honorary President. In the latter capacity His Late Majesty, when Prince of Wales, opened the proceedings of the International Statistical Institute when the Society were their hosts in 1905. His son the present King performed a like office at the Centenary Meeting of the Society in 1934. The Council addressed to His Majesty King Edward a message of loyal condolence and respect, and petitioned for the Patronage of His Majesty. This was graciously accorded in a letter received in April. A reproduction of the Address appeared in Part II of the *Journal*.

For nearly fifty-two years the Society found a pleasant home in Adelphi Terrace, and it was with intense regret that the Council found

themselves compelled, on account of the replanning of that area by the owners, to move at short notice from a spot which had for them so many associations. In this emergency, the Governors of the London School of Economics and Political Science generously provided them with temporary accommodation at No. 4 Portugal Street (formerly the W. H. Smith Memorial Hall). While the surroundings are not as congenial as at Adelphi Terrace, the new premises have, at least, the advantage that the Society's Library is now housed in a more accessible manner. It is certain, however, that the present accommodation will not long continue to be sufficient, and when the Governors of the London School resume their building operations they may be able to provide the Society with more commodious and appropriate premises.

The Council also desire to express their indebtedness to Mr. Calvert Spensley, without whose wholehearted assistance the removal could not have been carried out so efficiently and expeditiously.

A Guy Medal in Silver has been awarded by the Council to R. G. Hawtrey for his paper, "Public Expenditure and Trade Depression," read before the Society in April, 1933, for his previous papers, and also for the valuable contributions he has made to discussions at the meetings.

The Council have further awarded a Guy Medal in Bronze to W. G. Cochran, for his paper on "Statistical Analysis of Field Counts of Diseased Plants" read to the Study Group in November, 1935, and printed in the Supplement, No. 1, 1936. This is the first award of the Bronze Medal.

The Frances Wood Memorial Prize, offered for competition in 1935, was awarded by the Council to C. V. Dawe, of The Agricultural Advisory Office, Bristol, for his essay on "An Economic Interpretation of the Agricultural Statistics relating to the Bristol Advisory Province," and was presented to him at the Ordinary Meeting on February 18th, 1936.

In February of this year the Council addressed a Memorial to the Minister of Labour, printed in Part II of the *Journal*, asking that fresh investigations should be undertaken into the earnings of labour and the cost of living. It was formally acknowledged, and the Minister subsequently announced that he was prepared to undertake the revision of the cost-of-living index. He has appointed an advisory committee, of which the following Fellows are members: Professor Bowley, C. T. Houghton, D. Caradog Jones, and E. C. Ramsbottom.

A Memorial was also sent to the Lords Commissioners of H.M. Treasury suggesting that it would be for the public benefit if official publications of general interest were sold at specially low prices, so as to facilitate their wider circulation. No reply has yet been received.

In the year ended May 31, 1936, 1,075 works were added to the Library, compared with 1,176 the year before. These figures exclude periodicals regularly received and a number of Parliamentary Papers. During the same period 1,304 volumes were borrowed by 569 Fellows, against 1,618 by 795 Fellows the year before. The Library was closed for two months owing to the removal.

The Fellows named below (nominated in accordance with Byelaw 14) are recommended for election as President, Council and Officers of the Society for the Session 1936–37 :—

President.

The Rt. Hon. Lord Kennet of the dene.

Council.

Sir Percy Ashley, K.B.E., C.B.	Leon Isserlis, D.Sc.
*Sir William Beveridge, K.C.B.	H. Stanley Jevons, B.Sc.
M. S. Birkett, O.B.E.	Prof. J. H. Jones.
J. Bonar, LL.D., Litt.D., F.B.A.	J. Maynard Keynes, C.B.
Prof. A. L. Bowley, Sc.D., F.B.A.	A. W. Waterlow King.
L. R. Connor, M.Sc.	H. Leak.
J. Iris Douglas.	H. W. Macrosty, O.B.E.
Major P. Granville Edge, O.B.E.	Egon S. Pearson, D.Sc.
W. Palin Elderton, C.B.E., F.I.A., F.F.A.	George Rae, D.Sc.
Barnard Ellinger, C.B.E.	E. C. Ramsbottom, O.B.E.
*Dorothy P. Etlinger.	E. C. Snow, D.Sc.
R. G. Glenday, M.C.	*J. Calvert Spensley, O.B.E.
R. G. Hawtreay.	S. P. Vivian, C.B.
David Heron, D.Sc.	*A. D. Webb, C.B.E.
*J. O. Irwin, D.Sc.	*F. Yates.

Those marked * were not Members of Council during the preceding Session.

Honorary Treasurer.

A. W. Waterlow King.

Honorary Secretaries.

H. W. Macrosty, O.B.E. E. C. Snow, D.Sc.
Leon Isserlis, D.Sc.

Honorary Foreign Secretary.

E. C. Snow, D.Sc.

The abstract of the Treasurer's account of receipts and payments and the balance sheet as on December 31, 1935, together with the report of the Auditors on the accounts for the year 1935, are appended.

Signed on behalf of the Council,

M. GREENWOOD,

President.

H. W. MACROSTY,

E. C. SNOW,

L. ISSERLIS.

} *Hon. Secretaries.*

June 10th, 1936.

APPEN

A.—(i) RECEIPTS AND PAYMENTS ACCOUNT FOR

Year 1934.			RECEIPTS.	Year 1935.		
£	s.	d.		£	s.	d.
1,459	10	0	Annual subscriptions :—			
113	8	0	For current year (698½)	1,466	17	0
52	10	0	Arrears (68)	142	16	0
			In advance (30)	63	0	0
1,625	8	0		1,672	13	0
441	14	0	Dividends and interest (including in-			
725	0	8	come tax refunded)	436	2	0
7	17	6	Journal sales (including reprints) ...	797	5	1
30	12	2	„ advertisements	12	1	6
5	16	3	Sale of Supplement	66	15	6
—			„ other publications	6	6	9
8	10	0	Special subscription	21	0	0
30	0	0	Study Group subscriptions	4	10	0
			Use of rooms	52	10	0
2,874	18	7	Total of Ordinary Receipts	3,069	3	10
136	10	0	Life Compositions	84	0	0
14	2	6	Refund, from Centenary Account, of			
			expenses incurred in 1932 and 1933	—		
3,025	11	1		3,153	3	10
425	13	5	Excess of Payments over Receipts ...	203	1	7
£3,451	4	6		£3,356	5	5

DICES

THE YEAR ENDED 31st DECEMBER, 1935.

Year 1934.		PAYMENTS.		Year 1935.	
£	s. d.			£	s. d.
		Journal (including reprints) :—			
629	2 10	Printing and paper ...	...	659	19 11
96	10 0	Reviewing ...	...	97	0 0
25	6 0	Reporting ...	...	25	19 6
63	5 11	Distribution ...	...	97	14 8
—		Repurchase ...	...	3	0
814	4 9			880	17 1
124	16 2	Meetings (including printing and postage) ...			
52	2 3	Library books ...	...	136	13 7
51	5 6	„ binding ...	...	57	2 4
1,010	14 0	Salaries and wages ...	...	60	1 9
380	0 0	Rent ...	...	1,071	7 4
2	7 6	Land tax ...	...	380	0 0
14	6 4	Insurance ...	...	2	7 6
98	7 10	Fuel, light and water ...	...	14	7 11
36	18 2	House expenses ...	...	79	16 2
6	0 6	Repairs to premises, etc. ...	...	26	2 0
8	6 9	Furniture and equipment ...	...	26	10 6
47	3 4	Postage, carriage and telephone ...	...	4	18 6
123	13 9	Stationery and miscellaneous printing	...	62	13 9
		Research Section :—	£ s. d.	118	2 6
69	11 6	Meetings ...	48 17 10		
247	14 9	Supplement ...	233 9 11	282	7 9
11	6 5	Study Group expenses ...	...	4	3 1
8	1 8	Miscellaneous ...	...	10	8 8
2	7 6	Guy Medals ...	...	40	5 0
3,109	8 8	Total of Ordinary Expenditure ...	...	3,258	5 5
136	10 0	Amount carried to Life Composition Fund (see Balance Sheet) ...	...	84	0 0
—		Subscription to Int. Scientific Congress	...	10	10 0
—		Loyal Address ...	...	3	10 0
107	19 4	Grant to Centenary Fund ...	...	—
97	6 6	Special expenditure on Library shelving and extra assistance ...	...	—
£3,451	4 6			£3,356	5 5

APPEN

A.—(ii) BALANCE SHEET

Year 1934.			LIABILITIES.	Year 1935.		
£	s.	d.		£	s.	d.
52	10	0	Advance annual subscriptions ...	63	0	0
77	2	6	Advance Journal subscriptions ...	99	7	0
207	16	11	Sundry creditors	138	6	0
<hr/>				<hr/>		
337	9	5		300	13	0
1,776	12	0	Life composition fund. (Including £84 for Life Compositions received in 1935 and £60 18s. for adjustments of previous deductions made in error)	1,921	10	0
			Balance in favour of the Society (exclusive of (1) Books in Library, (2) Journals and other publications in stock, and (3) Pictures, Furniture and Fixtures)	7,432	0	2
7,688	3	10				
<hr/>				<hr/>		
£9,802	5	3		£9,654	3	2
<hr/>				<hr/>		

BUILDING FUND (ESTAB

On 31st December, 1934, the Fund consisted of £738 5s. 3d. 3½ per cent. Con during 1935 (£53 7s. 5d.) were invested in £24 19s. 6d. 3½ per cent. Con of £763 4s. 9d. 3½ per cent. Conversion Loan, and £700 14s. 1d. 4 per cent. tively) being £1,627.

FRANCES WOOD MEMORIAL FUND

On 31st December, 1934, the Fund consisted of £500 4 per cent. Preference During 1934, dividends of £17 8s. 9d. were received, and the Fund was the Fund consisted of £500 4 per cent. Preference Stock, London, and £139 4s. 10d. cash at bank.

REPORT OF

“We have examined the foregoing Receipts and Payments Account, Balance Wood Memorial Fund with the Books and Vouchers of the Society and is, in our opinion, properly drawn up so as to exhibit a true and correct verified the Investments and Cash Balances.”

DICES

AT 31ST DECEMBER, 1935.

Year 1934.			ASSETS.	Year 1935.		
£	s.	d.		£	s.	d.
			Investments, at cost or under :—			
1,185	0	0	£2,236 11s. 3d. 2½% Consols (General Fund)	1,185	0	0
5,580	0	0	£10,527 12s. 3d. 2½% Consols (Guy Bequest)	5,580	0	0
1,299	0	0	£1,841 3½% Conversion Loan	1,299	0	0
490	0	0	£500 3½% War Loan	490	0	0
800	0	0	£1169 17s. 6d. 3% Local Loans Stock	800	0	0
			£666 4% 2nd Pref. Stock, L. & N.E. Rly.			
100	0	0	£266 5% Prefd. Ord. Stock, L. & N.E. Rly.	100	0	0
25	0	0		25	0	0
9,479	0	0	(Market value, 31 Dec., 1935, £14,897)	9,479	0	0
			Cash :—			
			On deposit			
			On current account			
			In hand			
210	4	9		91	3	2
84	0	0	Arrears of annual subscriptions recoverable (say 40)	84	0	0
29	0	6	Sundry debtors	—	—	—
£9,802	5	3		£9,654	3	2

(ESTABLISHED 10TH JULY, 1873).

version Loan, and £877 8s. 9d. 4 per cent. Consols. The dividends received version Loan, and £23 5s. 4d. 4 per cent. Consols, and the Fund now consists Consols, the total value at 30th December, 1935 (at 107½ and 114½ respec-

(ESTABLISHED 13TH MAY, 1920).

Stock, London, Midland & Scottish Railway, and £117 6s. 1d. cash at bank. credited with £4 10s. 9d. income tax refunded. Thus at 31st December, 1935, Midland & Scottish Railway (value at 30th December, 1935, at 83, £415),

THE AUDITORS.

Sheet, and Statements in regard to the Building Fund and the Frances find them to be in accordance therewith. We report that the Balance Sheet view of the state of the Society's affairs, as shown by the Books. We have

(SIGNED) J. W. VERDIER.
A. M. SOUTHALL.
R. F. GEORGE.

APPEN

B.—STATEMENT OF THE CONDITION OF THE SOCIETY

Year.	Constitution.				Fin					
	Number of Fellows at end of Year.		Changes during the Year.		Receipts.					
	Totals.	Life Fellows included therein.	Gains by Election, &c.	Losses by Death, &c.	Annual Subscrip- tions.	Com- posi- tions. ¹	Divi- dends, Interest, &c. ²	Journal Sales.	Other Items.	Totals.
1911	867	174	62	40	£ 1,415	£ 126	£ 341	£ 308	£ 65	£ 2,255
1912	854	175	44	57	1,336	105	341	334	41	2,157
1913	846	174	53	61	1,331	84	341	294	58	2,108
1914	821	169	39	64	1,281	42	339	271	51	1,984
1915	772	163	12	61	1,243	63	319	268	32	1,925
1916	758	163	34	48	1,181	42	284	325	18	1,850
1917	757	161	40	41	1,186	53	276	311	130	1,956
1918	761	167	47	43	1,132	222	456	305	3	2,119
1919	796	172	91	56	1,297	273	276	603	10	2,459
1920	882	180	123	37	1,373	251	291	730	95	2,740
1921	946	186	112	48	1,481	231	603	662	39	3,015
1922	969	187	71	48	1,499	126	454	689	142	2,910
1923	996	195	66	39	1,476	242	506	739	114	3,075
1924	1,002	194	68	62	1,638	105	400	666	81	2,890
1925	1,030	195	79	51	1,611	189	399	807	43	3,049
1926	1,054	197	77	53	1,619	116	404	780	112	3,031
1927	1,074	199	62	42	1,665	84	376	792	84	3,001
1928	1,079	201	56	51	1,680	84	397	748	87	2,996
1929	1,076	202	61	64	1,804	137	400	866	124	3,331
1930	1,058	204	50	68	1,663	126	451	1,026	680 ⁵	3,946
1931	1,064	208	62	56	1,667	115	452	948	80	3,262
1932	1,031	210	46	79	1,621	126	460	824	54	3,085
1933	1,024	205	56	63	1,586	21	435	723	122	2,887
1934	1,037	207	62	49	1,625	136	442	725	98	3,026
1935	1,051	205	67	53	1,673	84	436	797	163	3,153

¹ Life Compositions have been carried to a special Fund from 1921 onwards, and are included among the payments in "other items" column.

² Includes amounts carried to Life Composition Fund from 1921 onwards.

³ Exclusive of the Building and Frances Wood Memorial Funds.

⁴ Includes £395 for Catalogue printing in 1922.

DICES

DURING THE LAST TWENTY-FIVE YEARS, 1911–1935.

Payments.							Market Values of Investments at end of Year. ³	Year.
Journal.	Meet ings.	Library (Books and Binding)	Salaries and Wages.	Rent.	Other Items. ²	Totals		
£	£	£	£	£	£	£	£	
621	89	104	602	380	576	2,372	10,874	1911
725	85	81	620	380	283	2,174	10,599	1912
658	76	79	632	380	233	2,058	10,092	1913
793	82	88	615	380	361	2,319	9,528	1914
458	64	40	480	380	222	1,644	8,182	1915
516	50	36	492	380	181	1,655	7,702	1916
413	71	54	516	380	199	1,633	7,656	1917
651	91	33	534	380	211	1,900	8,282	1918
774	86	50	645	380	349	2,284	7,672	1919
913	89	99	904	380	454	2,839	6,848	1920
900	110	94	954	380	390	2,828	7,605	1921
983	98	103	1,006	380	755 ⁴	3,325	8,605	1922
922	146	107	1,010	380	445	2,940	8,666	1923
947	127	138	1,022	380	357	2,971	8,962	1924
940	132	116	1,021	380	373	2,962	8,423	1925
1,144	131	98	991	380	366	3,110	8,122	1926
1,213	150	119	899	380	302	3,063	8,375	1927
835	136	104	793	380	517	2,765	8,343	1928
839	150	156	878	380	238	2,741	8,462	1929
841	151	120	864	380	408	2,764	9,636	1930
903	147	206	921	380	376	2,933	9,151	1931
1,053	161	235	1,005	380	384	3,218	12,908	1932
809	149	96	1,001	380	330	2,765	13,167	1933
1,061 ⁵	194 ⁶	103	1,001	380	712 ⁷	3,451	15,839	1934
1,114 ⁸	185 ⁶	117	1,071	380	489	3,356	14,897	1935

⁵ Includes £600 from sale of *Times* in 1930.⁶ Includes meetings of the Research Section.⁷ Includes special expenditure on Library and grant to Centenary Fund.⁸ Includes Supplement.

PROCEEDINGS OF THE ONE HUNDRED AND SECOND ANNUAL GENERAL MEETING OF THE ROYAL STATISTICAL SOCIETY, HELD IN THE HALL OF THE ROYAL SOCIETY OF ARTS ON TUESDAY, JUNE 16th, 1936.

The Chair was taken by the President, PROFESSOR MAJOR GREENWOOD, F.R.S., at 5.0 p.m.

The HONORARY SECRETARY read the notice convening the meeting.

The CHAIRMAN presented the Annual Report of the Council for the financial year 1935 and the Session 1935-36 (which according to custom was taken as read) and moved that the Report be adopted and printed in the *Journal*. The motion was seconded by Dr. Irwin and was carried unanimously.

The CHAIRMAN announced that the Council had awarded the Guy Medal in Silver to Mr. R. G. Hawtrey for his paper "Public Expenditure and Trade Depression," read before the Society in April, 1933, for his previous papers, and also for the valuable contribution he had made to discussions at the Society's meetings; and that a Guy Medal in Bronze had been awarded to Mr. W. G. Cochran for a paper on "Statistical Analysis of Field Counts of Diseased Plants" read to the Study Group in November 1935.

The HONORARY SECRETARY announced that in accordance with Bye-Law No. 9 the Council had ordered the names of thirteen Fellows to be removed from the roll as those of defaulters. The list of names was laid on the table.

The ballot for the President, Council, and Officers for the Session 1936-37 was then taken, Mr. Williamson and Mr. Harris being appointed scrutineers.

As a result the Chairman announced that all those named in the list put forward for ballot had been unanimously elected for the various offices.

DR. BUTLER said that he would like to perform a very obvious duty—that of proposing a vote of thanks to the retiring President and to the Council. He had been told that no speech was required on these occasions, and since nothing that one could say could possibly enhance the value of the services for which the Fellows, he felt sure, wished to express their gratitude, he would without further words propose the vote of thanks.

MR. STEWART-JONES expressed his pleasure in seconding the motion, which on being put to the Meeting was carried unanimously.

The CHAIRMAN said that on behalf of the Council and Officers of the Society he tendered very hearty thanks. The work for the Society was a labour of love and he felt sure that all had been delighted to render such service as they could.

The Meeting then adjourned for the Ordinary Meeting.

REVIEWS OF STATISTICAL AND ECONOMIC BOOKS.

CONTENTS.

	PAGE		PAGE
1.— <i>Van Deuren (P.)</i> . Applications des Probabilités ...	787	9.— <i>Angell (J. W.)</i> . The Behaviour of Money ...	797
2.— <i>Van Uven (M. J.)</i> . Mathematical Treatment of the Results of Agricultural and other Experiments ...	788	10.— <i>Kuczynski (R. R.)</i> . The Measurement of Population Growth ...	799
3.— <i>Wicksell (Knut)</i> . Interest and Prices ...	789	Population Movements ...	799
4.— <i>Tintner (G.)</i> . Prices in the Trade Cycle ...	790	11.— <i>Gluss (D. V.)</i> . The Struggle for Population ...	803
5.— <i>Harris (S. E.)</i> . Monetary Problems of the British Empire ...	793	12.— <i>Reynolds (L. G.)</i> . The British Immigrant ...	805
6.— <i>Myers (M. G.)</i> . Paris as a Financial Centre ...	794	13.— <i>Gayr (A. D.)</i> . Public Works in Prosperity and Depression ...	806
7.— <i>Hubbard (L. E.)</i> . Soviet Money and Finance ...	796	14.— <i>Richards (H. I.)</i> . Cotton and the A.A.A. ...	808
8.— <i>Smith (D. Throop)</i> . Deficits and Depressions ...	797	15.— <i>Jackman (W. F.)</i> . Economic Principles of Transportation ...	809
		16.—Other New Publications ...	812

1.—*Applications des Probabilités*. By P. Van Deuren. Namur: Editions Wesmael-Charlier, 1935. 10" x 7". xvi + 556 pp.

This book is a sequel to a book by the same author: *La Théorie des Probabilités*, which was reviewed in Vol. XCIX (1936), part I of this Journal. The applications are grouped into six sections. (1) Theory of statistics. This is concerned mainly with the estimation and test of significance of a mean of a normal sample. (2) Errors of observation. The least squares solutions of the common problems are given. (3) Games of chance. A criterion is developed to judge to what extent any game is favourable or unfavourable to the players. (4) Life insurances. This contains an interesting account of the construction of mortality tables and the calculation of equitable rates for the usual types of insurance. The problem is also discussed from the point of view of the insurance company, which does not wish to face the prospect of bankruptcy and is accumulating a reserve. (5) The theory of gunnery: the correction of the setting of a gun after some trial shots. (6) Various applications by different authors: (a) To decide whether the integers 0, 1 . . . 9 occur at random in the expansion of any number in decimal form, (b) statistical mechanics, (c) astronomy, (d) telephone exchange systems.

The applications cover a very wide field. The same criticisms apply to this as to the previous volume: the mathematical equipment used can only deal with cases of normal distribution, and even then only with large samples. It is a pity that certain of the modern developments are omitted, because this defect occasionally mars

the shrewdness of judgment which is apparent throughout both volumes. For instance, there is no proper objective technique used to test goodness of fit; on page 102 an example is presented as showing a good fit of a normal distribution, in which the reader cannot make a test of the goodness of fit because all observations are expressed as percentages of the total, which is not itself given. On page 490, the significance level of the largest of ten deviations is treated as if it were the same as that of a single deviation. The estimation and test of significance of a mean are based on the *domaine pratiquement certaine*, an idea analogous to that of fiducial probability limits, yet the normal distribution is used instead of Student's *t*-distribution even with small samples.

The most interesting sections to the reviewer were those on life insurance, statistical mechanics and telephone exchange systems. To those unfamiliar with these applications of statistical theory, the sections concerned can be recommended as a lucid introductory account.

W. G. C.

2.—*Mathematical Treatment of the Results of Agricultural and other Experiments*. By Dr. M. J. Van Uven. Groningen and Batavia: P. Noordhoff. 1935. $9\frac{1}{2}'' \times 6\frac{1}{2}''$. 310 pp. 9.5 f.

In this very valuable text-book, written by a mathematician, the research worker who is not well versed in higher mathematics will find the groundwork of the statistical methods which he requires in the analysis of his experimental data. The author believes that the experimenter, who spends much time and energy in carrying out his observations, should take equal pains in the mathematical elaboration of his results, and hoping to dispel the mathematical apathy characteristic of most biologists, he gives in this book most of the requisite theory in terms of high-school mathematics. Calculus is used in only a few cases. Although simplicity of presentation has been adhered to, the book makes difficult reading, and it is doubtful whether the majority of those for whom it is intended will persevere with its study. Those who do persevere will be amply rewarded; they will have the satisfaction of knowing why they apply certain rules, and why they should choose one method in preference to another. The reader is not asked to accept anything for granted: complete proofs are given, and in this respect the book under review contrasts with other text-books dealing with statistical methods.

The first five chapters are devoted to the study of direct and indirect observations, and embrace the calculation of representative values and of the mean error. Chapter VI gives a discussion of probability and the significance of the mean error. Chapter VII is of a purely theoretical nature, and deals with the difference between the ideal or errorless value of a function and the asymptotically averaged value. In the chapters which follow the author proceeds to the adjustment of data by the method of least squares, and the algebraic treatment of observations in two or more variables. The lay-out of field experiments is next considered, and methods of dealing with an irregular distribution of fertility are discussed. The chapter which follows deals with the types of lay-out evolved by

Fisher, and with the theory underlying the analysis of variance. To this subject the author gives very detailed treatment, and it is noteworthy that he does not appear to attach as much importance to the necessity for random distribution of treatments as Fisher does. The book ends with a chapter on the adjustment of direct conditioned observations, and in this, as well as in all other chapters save one, fully worked numerical examples are included. The more technical aspects of Chapters VI, VII, VIII and XII are treated in greater detail in Appendices.

The book is written in excellent English and clearly printed on strong paper; it is hoped that it will be welcomed by the research worker who is serious in his desire to attain mathematical efficiency in the treatment of his data. J. Br.

3.—*Interest and Prices; a Study of the Causes Regulating the Value of Money.* By Knut Wicksell. London: Macmillan (on behalf of the Royal Economic Society), 1936. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. xxxi + 219 pp. 12s. 6d.

The appearance of an English translation of Wicksell's classic work is long overdue, and it is a matter of satisfaction that the undertaking has been entrusted to the highly competent hands of Mr. R. F. Kahn.

The subject of the use of the discount rate as an instrument of credit regulation is one which was developed in practice before it found a place in economic theory. It was evolved by the Bank of England from about 1830 onwards, and little was written about it till the time of Bagehot. Marshall was the first economist to embody it in monetary theory, and Wicksell gives recognition (not wholly unqualified) to the importance of Marshall's evidence before the Gold and Silver Commission.

Wicksell's book was the means of introducing this theory to Continental economics. But it was not merely a channel of communication; it contained important original contributions to the subject. Of these the best known is his theory of a natural rate of interest. This was logically involved in the theory that the rate of interest is the cause of changes in the price level. If a "high" rate of interest causes a fall of the price level and a "low" rate of interest a rise, there must be some middle rate with reference to which the rate is to be regarded as high or low. That middle rate, being itself, therefore, neither high nor low, can only be defined as that "which is neutral in respect to commodity prices, and tends neither to raise nor to lower them" (p. 102).

Wicksell threw new light on the problem of the relation of the rate of interest to prices when he pointed out that the natural rate fluctuates. "It depends on the efficiency of production, on the available amount of fixed and liquid capital, on the supply of labour and land, in short on all the thousand and one things which determine the current economic position of a community" (p. 106). He did not expressly include rising or falling price levels as reacting upon the natural rate of interest, but in a later passage he refers to this topic. "It is possible . . . to picture a steady, and more or less

uniform rise in all wages, rents, and prices (as expressed in money). But once the entrepreneurs begin to rely upon this process continuing—as soon, that is to say, as they start reckoning on a future rise in prices—the actual rise will become more and more rapid” (p. 148). Similar reasoning applies to a fall of prices (pp. 149–50). “There is thus no doubt that tremendous fluctuations in prices may be brought about by some cause which is quite trivial in itself although it has real and lasting effects.”

Wicksell never arrived at a satisfactory account of how the rate of interest influences economic activity. He looked for the solution in the effect of interest as a part of costs in general, and therefore as a greater or smaller deduction from profits. So regarded, the gain or loss through a change of one-half or one per cent. in the rate of discount would be “*too small* to exert more than a very diminutive influence on the structure of prices” (p. 90). It would become perceptible in the “case where raw materials or labour will be employed for one, two or three or more years before the finished product emerges” (p. 91), still more in the case of long-term investments. And he is apparently led to the conclusion that, for a low rate of interest to work, “it is a necessary condition that the easier terms of short-term lending shall have persisted sufficiently long to influence the long-term rate.” Thereupon, however, he qualifies this view, and points out that “a fall in the rate of interest, even though it is casual and temporary, will bring about a perfectly *definite* rise in prices. . . . If the rate of interest remains at a low level for a considerable period of time, its influence on prices must necessarily be *cumulative*.” And when he comes to the “systematic exposition” of his theory (chapter 9), he actually excludes dealings in capital goods “of very high durability,” such as houses or railways, which should be regarded “not as capital goods but as a kind of rent-earning goods” (p. 126).

There is some confusion of thought here. Wicksell never arrived at the idea that the purchase of goods with borrowed money can be regarded in isolation from the other transactions of a business, and that a gain which is negligible as a stimulus for the expansion of the operations of a business *as a whole*, may nevertheless have a very material bearing on the decisions how often and in what quantities additional stocks either of materials for manufacture or of goods for sale should be laid in.

R. G. H.

4.—*Prices in the Trade Cycle*. By Gerhard Tintner. With 2 Figures, 37 Tables and 60 Graphs. Austrian Institute for Trade Cycle Research in Co-operation with the London School of Economics and Political Science. Vienna: J. Springer, 1935. xii + 204 pp. Rm. 23.80.

This work is primarily an analysis of the movements of wholesale prices in the period 1845–1913. Some 270 price series are considered, principally from England (where Sauerbeck's original manuscripts were made available by the Royal Statistical Society), the United States (based on Mill's *The Behaviour of Prices*) and Germany, with smaller numbers from Holland, Austria and Russia. An enormous amount of arithmetical and algebraic calculation has

been involved, and the Austrian Institute and Dr. Tintner are to be congratulated on the successful completion of a Herculean task.

No student of Trade Cycles can afford to neglect this study. No new theories are advanced, but the statistics are arranged in such ways as to be available for testing many hypotheses—not all, for the original statistics are not given. The worked-up series for 26 commodities are to be found in ingenious transparencies in packets at the end of the volume.

The method by which the original price series are analysed deserves careful study. The data are monthly prices (quarterly in some cases). It is assumed that each series is the resultant of: (1) casual influences, (2) seasonal influences, (3) cyclical movements and (4) long-period changes. The problem is to isolate the effects of the cyclical movements.

The seasonal changes are eliminated by taking successive averages of twelve (or rather of eleven and two half) months, beginning afresh each month. By this process any change in the seasonal pattern becomes unimportant.

For treatment of the casual variations the variate-difference method is followed, developed from Professor O. Anderson's well-known analysis. Each series is differenced successively till the variance of the residual becomes small and nearly unchanged. It is surprising that in 112 out of the series so treated it is sufficient to stop at the second difference, which leads simply to a moving average of three successive entries. With higher differences weighted moving averages are appropriate; 5, 7, 9 and 11 entries are used in respectively 35, 9, 8 and 9 cases.

This procedure assumes that any price depends on the addition of an element from an unclassified source to the result of a function which arises from classified causes, which function is of invariable form, at least over short periods. It may be pointed out that if, for example, the function is written $y = a + bt + ct^2 + v$, where t rises in arithmetical progression, v is a residual and a , b and c are regarded as constant, it is legitimate to suppose that these constants are modified in the course of the series, that is to suppose that the trend function gradually changes. This can be seen from the identification of the process with that of moving averages.

We have now series that are the presumed result of a trend and cyclical variations. The cyclical element is first removed by taking moving averages of periods that vary with the distance from one maximum to the next. It is unfortunately not explained how we pass from a period of, say, 35 months to one of 45 months. Finally the trend series so found is subtracted from the former series, and the remainders are taken as showing the cyclical effects isolated from all others. The resulting terms are expressed as percentages month by month of the corresponding value of the trend series, so that the results for different commodities can be compared with each other. This comparison is facilitated by the use of the transparencies already named.

The main criticisms of this method are those given by Professor Anderson himself in the *Journal of the Royal Statistical Society*,

1927, pp. 548 *seq.* There it is shown what a number of hypotheses, none of them verifiable, are concealed in the process. Anderson points out that the differencing process does not completely eliminate the residual, whence we deduce that though the variance is small, the casual element may be sufficient to displace the maximum by one or more months. We should notice also that it is assumed that the cyclical, seasonal and casual variations are independent of each other and of the trend, so that a function that represents them can be expanded by Taylor's Theorem continued only to the second term. This neglects not only correlation, but also other quantities which may in fact not be small. However, the whole process is only an elaborate method of smoothing by moving averages. Any rational method of smoothing will give approximately the same set of dates for maxima and minima. The suggestion may be hazarded that no method can give precise values for the *amount* of cyclical disturbance. Indeed, little precision is claimed for the method here used.

While the choice of method is interesting to the mathematical statistician, the economist is mainly concerned with the analysis of the series so obtained, which occupies the principal part of the book. The dates of general "boom" and "crisis," or "high" and "low" points are determined by taking the median of the dates where these occur in different series. 20 cycles are found in the period 1845-1913, of which 10 occur only in the English series. An important Table (IV) compares the dates of maxima and minima of the separate series with those allotted for the general cycles, and a study is made of the agreement between them. The measurement of correspondence appears to be too favourable. Consider, for example, the English series for tea, available only after 1873:—

Dates of Turning Points.

Months measured from January 1845.			
General Cycle.		Tea Prices.	
Maximum.	Minimum.	Maximum.	Minimum.
—	382	—	388
445	—	422	—
—	485	—	456
534	—	497	521
—	586	568	622
651	—	660	—
—	685	—	692
727	—	712	—
—	762	753	739
805	—	—	787

It is seen that it is difficult to arrange the dates even plausibly in parallel columns; but the process of reduction used results in the measurement that 7 out of 12 movements, or 56 per cent., agree (see p. 142, column 4: "consistency of response to the average cyclical movement").

On this liberal view of consistency the series are arranged in the order of these percentages in Table IX. As a rough classification this table is interesting, but it shows that the discrepancies between

the presumed cycles and the movements of individual series are very numerous.

In fact, the sections on the relationships between the cycles suggested by the separate series with each other are inconclusive, though some of the numerous classifications are suggestive. Every attempt at generalization appears to break down, and of this the author is fully aware. "The cyclical movements are less general and more varied than is usually supposed. In several countries certain industries show a cyclical course and rhythm which is quite different from those of other industries. The international connection of the national cycles of prices is in some respects not very close. . . ." "The question therefore remains open whether a theory of the cycle which gives several different causes for the cycle can not explain this varied behaviour better than one which attempts to trace it to a single cause" (p. 80).

While generalizations give negative results, there still remains the study of the behaviour of individual price series, which, in spite of its over-elaboration, contains much that is interesting and important.

A. L. B.

5.—*Monetary Problems of the British Empire*. By S. E. Harris, Lecturer on Economics, Harvard University. New York: Macmillan Co. 1931. 9" × 6"; xv + 569 pp. \$5.

The contents of this book are more limited than its title suggests. It is actually a survey of the monetary problems during the war period and the immediately succeeding years, and stops well before the developments that finally caused this country to go off gold. For the period with which it deals it gives a comprehensive and highly detailed review of Great Britain's monetary problems—so detailed, in fact, that any reader who has not already a considerable store of knowledge would probably find a difficulty in keeping a grasp of the main threads of the story. The author evidently must have had a suspicion of some such weakness, judging by the copious use he makes of summaries of his material. The book is divided into five parts, which are again divided into different sections. Each section starts with an introduction setting out the main lines of consideration, and ends with a summary recapitulating its contents in barest outline, and then, in addition, there is a summary to each part or group of parts. But all this retracing of the argument should not be necessary if the details were kept in focus and the main lines of development always held in view. This reliance on summaries is in effect an admission of a fundamental fault in the handling of the material, a fault, however, which their presence does not counteract, since they are too bald to be of any particular value. As it stands the book makes rather arid reading, which is a pity, since an enormous amount of research has gone to the making of it, and as the author makes copious references to the writings of the economists, it would with a rather better sense of balance have provided a most useful survey both of the problems involved and the views that have been held about them.

Mr. Harris has his own opinions on certain aspects of the subject.

He holds that the inflationary influence of the Treasury notes has been exaggerated, and emphasizes rather the shortage of supplies as the cause of high prices and the mistake, from a financial standpoint, of raising money wages so as to prevent a fall in the standard of living at a time when the supply of consumable goods was decreasing. He produces, however, no definition of what he means by inflation, and seems to use the term occasionally in a very loose sense. Thus he writes: "If scarcity prevailed, more emphasis should be put on the scarcity of supplies as an explanation of inflation" (p. 337). But a scarcity of supplies can only cause inflation in the sense that the circulating medium has failed to adapt itself to a falling volume of commodity transactions. If he is going to lay so much emphasis on scarcity of supplies, he must also consider, which he does not do, whether the Treasury note issue would not have prevented the adaptation of the volume of the circulating medium to the volume of transactions, assuming this to have contracted. Other points developed by Mr. Harris are that the inflationary effects both of War Loans and of Ways and Means advances have been exaggerated, but that, on the other hand, the unfavourable effect of the Bank's rediscounts of promissory bills and advances to acceptors have not been given sufficient attention.

When he turns to India and the Dominions the matter is much more briefly and less satisfactorily handled by the author. Thus, though he deals at some length with the imports of gold into India, there is only a brief reference to the purchases and remittances of silver by the India Office, and, moreover, there is only the barest mention of the unsuccessful attempt to fix the rupee at 2s. after the war. The problems of South Africa, Australia and Egypt are even more rapidly dealt with than those of India, and these cursory surveys coming after the highly elaborate consideration of developments in Great Britain make the book somewhat top heavy. It ends, however, with a very full and useful bibliography.

W. A. E.

6.—*Paris as a Financial Centre.* By Margaret G. Myers. London: P. S. King. 8½" × 5½". 192 pp. 10s. net.

Students of international banking and foreign exchange often make the mistake of assuming that each of three or four important countries possess identical monetary and banking systems. Bank rates in London, Paris and New York are compared with fatal facility, and a gold outflow from Paris is discussed as if its consequences were the same as those of a gold outflow from London. This mistake largely arises from ignorance of foreign banking systems. An English text-book will describe accurately and in some detail the operations of the British banks and the London money market, but a parallel description of Amsterdam, Berlin, Paris or New York falls beyond its scope, and the differences existing in foreign centres are either ignored or dismissed with a few words of warning. How many people here know that the *Banque de France* is both a central and commercial bank: or have ever heard of the *Caisse des Dépôts et Consignations*?

There was thus ample scope for a series of text-books describing

the leading foreign centres, and the present book represents an admirable attempt to fill this need, so far as Paris is concerned. It is brief, clear and objective. The author has no theories to advance, but instead she has consulted French authorities, read French documents, and has set down what she has learned. Beginning with the Banque de France, she proceeds to describe the Caisse des Dépôts et Consignations; the Treasury and its ramifications; the commercial and investment banks; the Bourse; and the money market. A useful appendix consists of the stabilization laws of 1926 and 1928.

It is possible to find minor points of criticism as the result of rigorous research. A table on p. 133 states that the total amount of cheques handled in a year by the London Clearing House runs into billions, in the English sense of millions of millions. This is an obvious slip, which mainly suggested to the reviewer the crying need of an international standardization of these astronomical units. In places the author's proper desire for brevity leads to a sudden jump either in history or in argument, or alternatively makes her transform a highly debatable point into an apparent fact. Those whose business lies in the Paris market could no doubt find technical points for query or discussion.

To an English reader there are one or two matters of more general criticism. First, the Paris foreign exchange market is treated far too cursorily. It really merits a separate chapter, which should also describe in detail the *Banque de France's* and other operations in gold, which rather strangely are not dealt with at all. There is no description of how the Banque de France buys or sells gold, of its conditions of purchase or delivery, and yet the practical steps it takes unofficially to discourage or encourage gold movements would afford scope for a most fascinating study. The second point is one for which the author cannot legitimately be blamed. Being herself an American, her comparisons are naturally with New York rather than with London, and such allusions as she makes to London often possess a foreign ring. This is not her fault, but it adds slightly to the difficulty of the English reader.

One defect in the book is small but vital, because it is a point which is often overlooked by writers of descriptive text-books. Now that conditions are changing so frequently and so rapidly, to give only the year of publication is not sufficiently precise. The preface ought to end with the exact date on which the manuscript or proofs passed finally out of the author's control, so that the reader can tell exactly how up-to-date the book is. I still have vivid personal recollections of an edition of a foreign exchange text-book which went irretrievably to press in August, 1931, but fortunately I took this precaution. To quote an example from this present book, the author states that the commercial banks never rediscount at the Banque de France. This was true up to last March or April, but I am reasonably certain that they had to rediscount during the late spring and early summer crises of this year. The doubt at once arises whether or not the book went to press before or after this enforced change in French banking practice.

In a sense the whole book is rapidly becoming out-of-date, for

M. Blum's Government have already put through their reforms of the Banque de France, and the future of the franc itself defies prediction. This adds to rather than detracts from the value of the book, because it presents a clear picture of the French financial system immediately before the present deluge. If anyone wishes to understand what is happening to the French financial system to-day, he cannot do better than read this book. It is true that he will need to supplement his reading with a study of general French economic conditions, including prices, costs, wages, general commerce and fiscal matters, but at least this book will provide him with the foundation. Within its self-defined limits it is an admirable study, and the publication of similar text-books dealing with other foreign financial centres would fill a real need.

N. E. C.

7.—*Soviet Money and Finance*. By L. E. Hubbard. London: Macmillan, 1936. 9" × 6". xiii + 339 pp. 12s. 6d.

Books on Russia are sometimes apt to recall the adventures of Alice, of Wells's Mr. Barnstaple, or, possibly, of Jules Verne's Captain Nemo, the mysterious figure whose mighty library covered every conceivable topic with one notable exception—books on political economy, it will be remembered, were rigorously excluded. Mr. Hubbard takes care to keep his book on a more matter-of-fact plane, and openly disavows any intention of evaluating the successes and reverses of Bolshevism.

But the book is less narrow in its scope than the title may suggest. The first part tells the evolutionary story from the fall of Kerensky up to recent times; the second part gives a more or less detailed description of the existing system of distribution and transport, of banking and credit, and sets out to explain Soviet financial theory and policy, which in the final part are further analysed and compared.

Some of Russia's problems are obviously not entirely new, and indeed remind us of our own problems after 1914—the allocation of man-power to channels deemed to be of national importance, the particular significance ascribed to special lines of manufacture, the subordination of price to production, and the privileged treatment of certain classes of wage-earners. Even the simultaneous taxation and government monopoly of commodities finds its counterpart in our war-time treatment of sugar. In dealing with these and the innumerable other and more novel problems faced by Russia, Mr. Hubbard evidently endeavours to describe the Soviet economy as objectively as he can.

Sometimes, however, he seems to disregard fundamental differences between the Soviet and capitalistic systems, as in his search for the "most profitable investment" (p. 263); or when he says that in deciding on the relative production of capital and consumption goods, "the Soviet Government, like any capitalist, must weigh up the advantages and disadvantages of investing its capital in the one way or the other, and the ratio of these two is very like a rate of interest" (p. 266); or when he suggests that if the claim that Soviet planning can overcome unemployment is to be substantiated,

"it must be shown that it is capable permanently of finding remunerative employment for the whole body of workers" (p. 283).

On the other hand, it occasionally appears doubtful whether the differences between Soviet Russia and capitalistic countries are so great and clear-cut as Mr. Hubbard would have us believe, as, for example, when he declares that under the Soviet a Treasury reserve of paper roubles would be of little use on the outbreak of war (p. 200), or when, in dealing with savings, he somewhat surprisingly tells us that Soviet "current capital expenditure is met by current revenue and there is no question of real saving at all" (p. 198).

On these and other points, Mr. Hubbard gives many interesting figures, but statistics are not an outstanding feature of his book. The budget and taxation receive relatively little attention, while the interesting question of the purchasing power of the rouble is relegated to a short appendix, in which the author concludes that "the average Russian can buy with his week's wages about as much food as the Londoner can buy with 9s." But a week's wages are not spent solely on food, and Mr. Hubbard's figures ignore important factors such as social services and rents, while the evidence adduced in support of his basic statement that the relevant "Moscow prices are four to five times higher than the London prices" is much too vague to be satisfying.

Nevertheless, Mr. Hubbard has collected between the covers of his book a great deal of valuable information on subjects which previous writers on Russia have almost without exception neglected or ignored, and he has provided a useful, if not an essential, supplement and guide to many of the numerous books on that much-discussed country.

C. O. G.

8.—*Deficits and Depressions*. By Dan Throop Smith, Ph.D. New York: John Wiley and Sons; London: Chapman and Hall, 1936. 8 $\frac{1}{4}$ " \times 5 $\frac{3}{4}$ ". vii + 264 pp. 12s. 6d.

In this book, based largely on American practice and English theory—in particular that of Hawtrey and pre-1936 Keynes—the author covers a good deal of ground in his general and theoretical study of the effects of Treasury financing on booms and depressions in the economic system. He sees many possible dangers ahead, but can offer little help, concluding that "no formula can be given, but human judgment must be relied upon to determine what forces are of overwhelming importance and what have only a negligible influence. The author's belief is that a sounder realism may be possible when the complex nature of any deficit analysis is appreciated."

C. O. G.

9.—*The Behaviour of Money*. By James W. Angell. New York and London: McGraw-Hill Co., 1936. 9" \times 6". xiv + 207 pp. 18s.

"These studies," Professor Angell explains in an introductory first chapter, "are essentially exploratory in character." He has set out to analyse statistics of cash in circulation and of bank deposits in the United States with a view to seeing what light they can be made to throw on problems of monetary theory and of monetary

policy. Some of his figures go back as far as 1890; others cover only the post-war period. The studies must be regarded as frankly experimental (Professor Angell lays emphasis on the crudeness of the material on which he is working) and as such they are of considerable interest.

The broad results of his investigation may be summarized as follows:—

(i) Outside currency (currency outside all banks and the Treasury) and circulating deposits (deposits subject to cheque, corrected for duplication) both tend to move *after*, and never *before*, the broad indices of production and trade.

(ii) There has been no uniform reaction to broad banking movements in the various Federal Reserve districts, though "a considerable group of districts did follow roughly similar general trends after 1923, and in a majority of cases the response of the other districts, *taken as a whole*, to foreign gold movements through New York was at least moderately uniform."

(iii) An examination of an index of the exchange velocity of money, taking as a basis $\frac{\text{BANK DEBITS}}{\text{CIRCULATING DEPOSITS}}$ (141 centres, a 60-70 per cent. sample), suggests that (a) the main factor in short-period changes in the index is that of debits; (b) New York figures are dominated throughout by financial transactions; (c) figures for the outside centres up to 1927, and again, though less clearly, from 1930 to 1934 are related to production and wholesale—though not retail—indices, while in 1928 and 1929 they are in the main bound up with financial transactions; (d) exchange velocity moves with or after other important factors; (e) for these and other reasons proposals for monetary control based on attempting to stabilize some form of exchange velocity of money are likely to prove dangerous.

(iv) An examination of the circular velocity of circulating money $\frac{\text{NATIONAL INCOME}}{\text{OUTSIDE CURRENCY} - \text{CIRCULATING DEPOSITS}}$ shows a high degree of stability from 1909 to 1930, with a great drop after 1930 owing to hoarding; it would appear that fluctuations in national income are more intimately associated with changes in the stock of circulating money than with changes in its average circular velocity.

From these results Professor Angell reaches a broad conclusion. "To put the whole matter briefly, if rather loosely, serious difficulties stand in the way of achieving desirable general economic objectives by enforcing artificial and presumably fairly frequent *fluctuations* in the quantity of money, no matter what criterion is used to guide this manipulation." On the other hand, it would appear to be "a plausible inference that, if the ultimate objective of policy is to induce a greater degree of stability in national and individual money incomes—an objective which is defensible and which has been accepted by many—then the most effective procedure is to stabilize the quantity of money itself. This quantity would not be held

absolutely constant, perhaps, but it would be allowed to change only gradually and evenly. Marked fluctuations in economic activity and in the national income would doubtless still remain, but there is ground for thinking that they would be far less severe and injurious than those from which we now suffer."

But however interesting Professor Angell's experimental examination, his conclusions do not follow unless one accepts an assumption which lies behind the whole investigation, and which is indeed dangerous. Professor Angell appears to assume that he is entitled to draw conclusions from the behaviour of "circulating money" without reference to time deposits: in generalized terms, that for his purposes he can consider money as a medium of exchange and neglect its functions as a store of value. "It is a familiar truism that, except for the usually unimportant phenomenon of hoarding, the possession of money is merely a means to an end, not an end in itself. . . . Such is the teaching of every elementary textbook," and such is the doctrine which Professor Angell accepts.

And it is precisely a doctrine such as this that recent economic thought—impressed with problems of liquidity and uncertainty—would uncompromisingly reject. Cash balances do serve an end in themselves in so far as their possession provides a defence against an uncertain future. The "hoarding" element, so far from being "usually unimportant," is an element which is always present and which in the main explains why people hold balances at all instead of spending them at the earliest opportunity. If the desire of individuals to hold balances against an unknown future is taken into account, it is clear that a monetary authority will at intervals be faced with positions in which individuals in general are anxious to build up balances or to reduce them. It is in the light of such considerations that more recent advocates have put forward proposals for what Professor Angell calls "artificial fluctuations in the quantity of money." Whether rightly or wrongly, they would advocate an offsetting of any new hoarding or dishoarding on the part of the business community. Professor Angell has not touched this position because he neglects the "store of value" functions of money in drawing his inferences, and confines himself to money as a means of payment.

Conversely, any attempt to stabilize the quantity of money, irrespective of whether the public is anxious to build up balances or reduce them, would tend to increase instead of minimize the strain on the economic system. Such, at any rate, is the view which is rapidly gaining ground. And these are the arguments which Professor Angell must meet before he can fairly claim to have established his conclusion.

A. T. K. G.

10.—*The Measurement of Population Growth*. By R. R. Kuczynski. London: Sidgwick and Jackson, 1935. vi + 255 pp. 12s. 6d.

Population Movements. By Robert R. Kuczynski. Oxford: Clarendon Press, 1936. 121 pp. 5s.

The first of these books deals mainly with principles, the second with results.

(1) The former is primarily a study of fertility: mortality is

only considered in so far as it counteracts the results of fertility, and immigration and emigration are not discussed at all. The reasons for this choice are twofold. In the first place, while in former times mortality was the decisive factor in determining population, now it is fertility. "With the ever-increasing spread of birth control the gap between fecundity and fertility has widened more and more. Mortality, on the other hand, no longer fluctuates extensively." Secondly, the measurement of fertility is not as widely understood as the measurement of mortality, and inadequate methods, the author considers, are often used.

The first chapter of the book gives some useful hints on methods of testing the accuracy of birth statistics. The second chapter deals with methods involving the use of registration statistics only; it is mainly devoted to a careful study of the ratio of births to marriages as a measure of fertility. All the defects are carefully considered, the complication of second marriages and illegitimate births, and especially the fact that if we take the ratio of births to marriages in the same year, the births are not related to the marriages which produced them. The third chapter deals with methods involving census statistics only. The fertility enquiry of the English census of 1911 is somewhat adversely criticized, and is said to make the decline of fertility appear considerably greater than it actually was.

Next we come to methods of which the author approves: the use of registration and census statistics in combination. Considerable stress is laid on the gross reproduction rate. This measure, obtained by totalling the specific fertility rates for each year of life throughout the child-bearing period (here taken as 15-50 years), gives the number of girls who would be born on the average to each woman who passed right through the child-bearing period. It is quite independent of mortality, and if it is less than unity, then, however low the death rate, the population could not, in the long run, maintain itself. After a good chapter on mortality, in which, however, the standardized death rate is somewhat harshly criticized, there is some consideration of the balance of births and deaths. Here it is the *net reproduction rate* which is stressed. This is the average number of girls born to each woman during the child-bearing period, taking the mortality of these women into account as well as their fertility. It is the net reproduction rate which measures whether the population is maintaining itself or not. In 1933 England had a net reproduction rate of 0.735, and for most of the countries of Europe it was less than unity; for the whole of Western and Northern Europe it was 0.76. The book concludes with a discussion of the conditions under which a population can remain stable, *i.e.* with the same birth rate, death rate and age composition.

This book, we think, gives too much space, initially, to criticizing the work of other writers of whose methods the author disapproves. It is only comparatively late that we come to a clear statement of the principles he thinks right, and which should have been placed first. Clearly much painstaking thought and computation have gone to its preparation, and the tables alone make it worth having.

(2) The second book contains the substance of three public lectures recently given at University College.

The first lecture deals with our knowledge of the population of the earth. There are about 150 million people in Africa, 250 million in America, 530 million in Europe, 1,100 million in Asia and about 10 or 11 million in Oceania. An interesting account is also given of the peopling of America with blacks and whites. The author estimates that after 1492 about 15 million negroes were imported into America (this being a conservative estimate) and about 40 million permanent white immigrants went there. The total number of whites at present in America is 172 millions, as against 40 million negroes.

In the second lecture the reduction of mortality and fertility and the balance of births and deaths are considered. Since 1770 the population of Europe has increased by about 250 per cent., and there are now about 720 millions of persons of European stock in the world as against 155 millions in 1770. The main reason for this "stupendous growth" is the increase in the expectation of life, which has "nearly doubled" in the last 165 years. It was 35 years in Sweden for the period 1755-75, and is now between 57 and 68 years for the countries of Western civilization. Fertility, according to the author, was in former times much lower than most people imagine. "Wives with 8 or more children constituted a small minority, and wives who had more than 5 children were probably not more numerous than those who had less." In the last fifty years, however, the decrease in countries predominantly inhabited by whites has been greater than is usually believed. "Fifty years ago the gross reproduction rate for Western and Northern Europe as a whole was 2.1. . . . By 1911-14 the gross reproduction rate had fallen to 1.6. It dropped below unity in 1931 and was 0.9 in 1933. This means that according to fertility for 1933 not more than 90 girls were born to 100 women passing through child-bearing age." The most startling conclusion in the final section of this lecture is this: "If the population of Soviet Russia continues to grow as, according to the official figures, it has grown from 1924 until 1934, it would by the year 2000 amount to 650 millions. If fertility and mortality remain in Western and Northern Europe what they were in 1933, the population, which now is about 193 millions, would reach its maximum of 196 or 197 millions in the late 1940's, and by the year 2000 would be reduced to 150 millions."

The final lecture deals with the possibilities of increasing reproduction and with public opinion on population movements.

In Northern and Western Europe further reduction in mortality cannot be expected to play much part in population increase, for it is only the mortality of women of child-bearing age that is relevant. "If no newly born girl died before having reached the age of 50, they would all live 35 years between the ages of 15 and 50. According to mortality for 1933 the average was 30.03 years in England and 32.17 years in New Zealand. In Northern and Western Europe as a whole the net reproduction rate was about 0.76 and the gross reproduction rate 0.9. If no girl died here before having passed

through child-bearing age, the net reproduction rate would be 0.9; if mortality of females under 50 were reduced by one-half the net reproduction rate would be 0.83."

Nor could an increase of nuptiality or the reduction of age at marriage much increase the population. The percentage of spinsters among females of 40-50 years averages about 14 per cent. in Northern and Western Europe. If these were to have married, the gross reproduction rate would not proportionally rise, because a number of children now born as illegitimate children would be born as legitimate children, and sterility is probably more frequent among those who do not marry than among those who do.

It is also easy, the author thinks, to over-estimate the effect of the reduction of age at marriage. "There are women who have children at 15 years and there are women who have children at 50 years, and many a woman might have a child either at 15 or at 50; but there have been hardly any women who actually had children both at 15 and 50 years. Of two equally fecund women who do nothing to prevent conception or to procure abortion and who have intercourse with procreative men, the one starting at the age of 17 and the other at 25, the first will bear children during a longer period than the second, but the difference will not amount to eight years: the first may have her last child, say, at 42 and the second at 47." The decline of fertility, the author considers, has been mainly due to the spread of birth control, and only an increased desire for children could increase it.

The final section of this lecture may help to remove some popular misconceptions. Here is an instance:—

"Let us assume for the sake of argument, that birth restriction should go so far that no child would be born in that country (America) during the next fifteen years. What would be the effect upon the labour market? Certainly not a single man would find work more easily because no more children were being born. As a matter of fact the number of persons looking for a job would increase in the next fifteen years, as in the past, because there would be more boys and girls reaching the bread-winning age than men and women leaving their jobs on account of old age, death, etc. The number of job-hunters might increase even more than before, because many young women who, if they had children, would not work might be looking for work if they had no children. What is still worse, the number of people thrown out of employment would increase at terrific speed. The industries catering for the needs of the youngest children would be the first to be ruined. They would be followed by those supplying the wants of the older children and so on. Teachers would lose employment, and so forth. . . . Conditions might change again when, in fifteen years from now, labour would become scarce because there would not be any young people to fill the positions then becoming vacant by reason of disability or old age, just as lodgings might become vacant in Germany twenty years after the cradles were left empty."

The book is a most fascinating account of modern population trends.

J. O. I.

11.—*The Struggle for Population*. By D. V. Glass. Oxford: Clarendon Press, 1936. 8 $\frac{3}{4}$ " \times 5 $\frac{1}{2}$ ". 148 pp. 7s. 6d.

The population of England and Wales has, it is well known, almost reached its peak; unless there is a pronounced change in the existing fertility rate it must very shortly exhibit a decline that will soon become rapid. Falling death rates will not be sufficient to prevent the movement; the future population trend must depend mainly upon fertility. Though many persons may for a variety of reasons, good and bad, welcome a cessation of the growth of our numbers, there are probably few who would wish to see a rapid decrease of the population. But can that decrease be averted? Can fertility be encouraged by any modification of the social and economic position of married people? That it can be is clearly the belief of the various European countries that, faced with a similar decline in numbers, have taken deliberate measures to stimulate their birth rates. If a population policy is to be devised and applied in Great Britain, much more information is needed than is at present available on the factors influencing the size of family. An obvious first step is to investigate the nature of the measures taken abroad, and, so far as possible, to assess the success, or lack of success, attending them. Foreign experience cannot be without interest and lessons for us. With such considerations in mind, the Council of the Eugenics Society decided to promote an inquiry. A Committee was set up consisting of Professor A. M. Carr-Saunders (Chairman), Mrs. E. Hubback, Miss M. E. Green, Mr. Julian Huxley, Professor R. A. Fisher and Dr. C. P. Blacker; a sum of money was provided to pay the expenses of investigation and the services of Mr. D. V. Glass were obtained to carry it out. Mr. Glass paid personal visits to France, Belgium and Germany to collect information that is not otherwise available in this country, and also to interview some of those officials who have been closely concerned with the operation of the various foreign schemes. The results of his inquiries are recorded in this very interesting little book. He has made it very readable by casting it in a form suitable for the general public, in a clear and simple style, relegating to notes and appendices more academic material which can be used for reference and some bibliographic notes. After a short analysis of the population position in England and Wales, he turns to the policies that have been adopted in Italy and Germany and to the family allowance systems in vogue in France and Belgium. With regard to the latter the general conclusion is that in France the system may have helped in reducing infant mortality (though perhaps due rather to the special medical services than to the actual payment of allowances), and possibly has prevented a still sharper decline in fertility than that actually observed. The allowance makes it easier to raise children, but gives no positive inducement in the sense of making the standard of life of parents higher than that of childless couples. Indeed, in spite of allowances, the raising of large families still means a very considerable drop in the standard of life, and it is impossible to expect them to have a really measurable effect upon the birth rate if the cost of bringing up a family is a material factor in keeping the size of family low.

The efforts of the Dictators likewise appear to have met with no phenomenal response from their devoted subjects. In Italy, taxes on bachelors, laws against birth control, tax exemptions and reductions for large families, marriage and birth premiums, better and cheaper houses, and schemes for reversing the industrial drift, have been met with declining birth and marriage rates. After more than seven years of active campaigning it is not easy to find any visible results. Although the Italian population is still more than replacing itself, it is doing so at a lower rate than in 1921, and there appears not the slightest chance of Mussolini's ambition of 60 millions in 1950 being achieved.

In Germany some success, at least on the surface, is apparent. The marriage rate began to rise in the second quarter of 1933 and the birth rate in the first quarter of 1934. The marriage loans have probably had, Mr. Glass thinks, an appreciable success, both by giving an inducement to marry and have the first child, and by reducing the tendency to procure abortions. On the other hand, there might even without the provision of the loans have been a considerable increase in the number of marriages in 1933 and 1934, owing to the postponement of marriages over the period of the economic depression. The responsible factors cannot be adequately differentiated, and there is no means of estimating the effect of a changed political system upon the willingness of German men and women to marry and have children. The rise in the birth rate, if maintained, is sufficient eventually to replace the present population by one no smaller in size, though containing a smaller proportion of potentially fertile women. There are, however, already indications that the high birth rate of 1934 was only temporary. From the records of the large German cities it is evident that births began to drop in the third quarter of 1935.

This analysis of the available statistics leads Mr. Glass to the conclusion that on the positive side we cannot learn very much from the experiments which have been tried in other countries. In France, Belgium and Italy the possible effects have up to the present been imperceptible. In Germany the circumstances in which the rise in the birth rate took place were abnormal. On the negative side we have the advantage of being able to descry some of the faults in the schemes instituted. For instance, since family allowances rarely cover more than 25 per cent. of the cost of bringing up a child, they can only offer an inducement to those people whose desire for children is relatively urgent; they may just turn the scales in favour of a child. We can hardly expect a significant change in the amount of marriage to result from a bachelor tax which, at its highest, is still far below the cost of a dog licence in Italy! In none of the countries examined does the Government really understand why there is a continuous fall in the birth rate, why people are restricting the size of their families. We need much more information before we really know the important forces which must be circumvented if the birth rate is to rise again. Mr. Glass suggests that the trend of modern house construction towards two- and three-bedroom houses has intensified the small-family movement (there seems here a possible danger of putting the

cart before the horse), that parental ambitions for their children have risen, that large families form a barrier to social intercourse and the numerous attractions outside the home. Our civilization is largely urban, and Mr. Glass maintains that it is obvious that the town is less fertile than the country and that the town depends to a very large extent upon the country for increasing or even maintaining its population. Is that so to-day? Some recently published figures give the legitimate birth rates per 1,000 married women aged 15-45 in 1930-32 as follows: England and Wales 123, Northern England (largely industrial) 127, London 119, rural districts of the South-eastern counties 119, county boroughs and urban districts of the same counties 111, rural districts of the South-western counties 117, and County boroughs and urban districts of these counties 109. The differences are not very pronounced. Mr. Glass's final conclusion is that until we have available detailed studies of movements within the population of this country and an analysis of the possible factors which are urging people to keep down the size of their families, attempts to raise the birth rate will be so much struggling in the dark with small chance of success. His present book will be of value to all those who are interested in our population problem, and it is to be hoped that he himself will be able to continue with the further investigations he outlines.

A. B. H.

12.—*The British Immigrant: his Social and Economic Adjustment in Canada*. By Lloyd G. Reynolds. Toronto and London: Oxford University Press, 1935. 8½" × 5½". xx + 364 pp. 12s. 6d.

This book, the second of a series of studies into social science problems undertaken by McGill University, Montreal, deals with the life history of the British immigrant into Canada. Considering first immigrants as a whole, the changing character of migration from the United Kingdom to Canada according to the degree of development of that country is shown. The first major cycle of pioneer development was the colonization of the Maritime Provinces in the latter half of the eighteenth century; the second, the settlement of Ontario during the first half of the nineteenth century, when the migration of agricultural colonists from the British Isles was again the most important factor; in the third phase, the peopling of the prairie and Pacific coast regions. British agriculturists failed to take the lead in the exploitation of the new area. The agricultural expansion in the West brought an expansion of secondary production in the central region, and it was here that the British immigrant, by reason of his training, found his greatest opportunity. "The data concerning the present-day distribution of British immigrants in Canada reveal the Britisher as essentially a town-dweller and a non-agriculturalist"—only 21 per cent. of the British-born gainfully employed in 1931 were engaged in agriculture. For this reason the detailed study of the economic and social adjustment of the British immigrant in Canada was confined to the British colony in Montreal, regarded as probably typical and representing nearly 8 per cent. of the total British-born in Canada in 1931. In that

city there are well-defined immigrant areas, dependent first upon nationality, and secondly upon social level. The growth of these and the tendency for successive waves of British immigrants to form new colonies on the outskirts of the city are described. The rapidity of absorption of British immigrants into the life of their new country depends upon many factors. Age is important, as is the immigrant's rural or urban background in Britain, but the most important factor is his income level, which is in turn dependent upon the occupational class to which he belongs. "Families of the clerical and artisan groups take root more thoroughly in Canadian soil than do families of the labouring class. . . . Few Britishers, however, ever become completely Canadian in their habits and outlook . . . the immigrant continues to cherish a deep-rooted conviction of the superiority of the British people and of the basic British institutions over those of all other countries, Canada included." The incidence of unemployment among British immigrants and their greater degree of social dependency than that of Canadians are dealt with in some detail. The result of the analysis suggests that the attempted encouragement of the migration of British agricultural workers to Canada under the Empire Settlement Act, 1922, was not well conceived. Many of those who went to Canada with the avowed intention of settling upon farms have stayed in or drifted back into the city. Of the British immigrants who settled in Montreal, it is shown that "probably at least four-fifths have achieved 'success' both in their own eyes and in the eyes of their neighbours," the failures being essentially unskilled manual workers. The book concludes with some specific recommendations as to immigration policy in Canada to the effect that (1) the present stringent regulations on the immigration of manual workers should be retained, not as a mere emergency measure, but as a permanent part of Canadian immigration policy, (2) the immigration of qualified clerks and domestic servants should be permitted to continue, subject to some control as to the numbers for each type of occupation to be admitted, and (3) that even if the drift from country to town could be checked by simply planting settlers on farms, there are thousands of potential settlers among Canada's urban unemployed who should be considered before the necessity for importing settlers from abroad is accepted. Having regard to the success of the British artisan in the past and his admitted contribution to the life of Canada, the suggestion that immigration of all such workers, and not only those of low grade, should be subject indefinitely to stringent regulation appears to be based upon a rather pessimistic view of the present employment situation in Canada rather than upon the evidence obtained in the course of the inquiry.

H. L.

13.—*Public Works in Prosperity and Depression*. By Arthur D. Gayer. New York: National Bureau of Economic Research (London: Macmillan). 9" × 6". xx + 460 pp. 12s. 6d.

The contest in this country during recent years between those who believed the cure for unemployment was best to be found through reducing the rate of interest and those who favoured the

remedy of public works has been fairly equally matched. While the "public-workers," as they have been dubbed, have been the more eloquent in their writings and more fluent in their advocacy, Government policy has until recently been on the side of the "interest-reducers," and the number of schemes of public works undertaken in this country has not been very large. In the United States, on the other hand, the contest has been more one-sided. The "public-workers" have had their way ever since the time when Mr. Hoover was Secretary of Commerce in 1923, and the change from the Republican to the Democratic Administration in 1933 meant only an extension of the programme of public works. Dr. Gayer has thus been able to make a study for the United States of a kind which could not be made for this country. He has made a factual as distinct from a theoretical study of public works, in order "to evaluate the possibility of utilizing planned public works as an agency of economic stabilization."

Dr. Gayer has collected all the material available relating to the volume and kinds of public works undertaken by the Federal State and Local Governments of the United States since the war. He has brought to this task all the expert skill of a professional economist and statistician, and his book is of the high standard expected from the author by those who are familiar with his previous work. The book brings up to date much of the material published in the volume by the National Bureau of Economic Research in 1930 by Drs. Wolman and Gayer on *Planning and Control of Public Works*. It was first presented as an official report by Dr. Gayer to the National Planning Board in 1934.

Although Dr. Gayer set out to write a strictly factual study of public works, he has apparently found it difficult to eschew all problems of theory. In his final chapter he tries to relate the conclusions drawn from his study to the theory of public works. He has, however, found himself in some difficulty. If he accepts the view that public works should be of a useful character, his conclusions are of considerable interest, but some readers will think he might with advantage have gone further in using his facts to check the validity of some of the assumptions made in theory. Although, for example, he discusses the "multiplier"—the generic k so familiar to students, he does not estimate its probable value. Perhaps Dr. Gayer is right to err on the side of caution. On the other hand, if he accepts the view that public works need not be of a useful character and that to insist they should be so is a mere pandering to popular sentiment, some readers may feel that while he has prepared valuable estimates of constructional activity and of public expenditure in various forms for the United States—which alone make his book well worth while—it is not quite clear how much of his detailed work is relevant to a discussion of "the possibility of utilizing planned public works as an agency of economic stabilization."

H. C.

14.—*Cotton and the A.A.A.* By Henry I. Richards. Washington, D.C.: The Brookings Institution, 1936. $8\frac{1}{4}'' \times 5\frac{1}{2}''$. 389 pp. \$2.50.

Since 1929, the policy of the American Government has been to seek to regulate the production and marketing of American cotton in an effort to increase the incomes of cotton growers. The stabilization experiments of the Federal Farm Board ended disastrously, but the lesson to be drawn from their failure, namely, that control of the marketing of cotton could not be successful without effective control of production, was not lost on those who drafted the Agricultural Adjustment Act for President Roosevelt in 1933. From 1933 until January, 1936, when the United States Supreme Court declared the Agricultural Adjustment Act unconstitutional, cotton production was subject to a rigorous scheme of control. Because the Agricultural Adjustment Act came to a legal end, it must always be a matter of debate among partisans what success it had, or what success it might have had if it had only been continued a little longer. Mr. Richards has attempted to give the answer in this book. He agrees there was an increase in the income of cotton farmers in 1933-35 but this increase "will be offset to a considerable extent by losses in the future because of expansion in foreign production and decreased foreign consumption of American cotton caused by the control scheme." He suggests "these future losses will probably much more than offset any increase in farmers' receipts from the sale of cotton during the first three seasons, but will probably not completely offset the increase in their income, including the cash benefits which they received from the American Government. Thus benefit payments, and not the price enhancement caused by production control, constituted the source of any net gain obtained." He concludes "raising cotton prices by a drastic curtailment of production increases growers' incomes for a time, but in the end results in losses to cotton growers."

Mr. Richards reaches these conclusions after a very thorough examination of the working of the Agricultural Adjustment Act and the supplementary Bankhead Act, and his conclusions should not be without their influence on those who are now seeking by means of suitably drafted soil conservation schemes to continue in operation the main principles of the Agricultural Adjustment Act. The value of Mr. Richards's book to the general reader, however, will lie principally in the clear objective account he gives of the working of the Agricultural Adjustment Administration from its beginning in 1933 with the ploughing up of ten million acres of cotton to the introduction of state and county quotas of production and the imposition of taxes on cotton ginned in excess of the quotas fixed. The final chapters, which deal with the general effect of the programme on income and on the future of American cotton in world markets, are, of course, more tentative, but there can be no hesitation in recommending this as the best book which has been written on one of the most interesting economic experiments of President Roosevelt's New Deal.

The main impression to be derived from Mr. Richards's book is

that if the cotton programme of the Agricultural Adjustment Administration can be said in any way to have failed, such failure cannot be attributed to lack of organization or enthusiasm in putting the programme into effect. The task of organization must have been immense, since there are two million cotton farms in the Southern States extending over thousands of square miles. Every farmer had to be consulted and Government officials had to see that individual contracts were carried out. It is certain there were abuses—deliberate overstatement of past yields, increasing the yields on uncontrolled acreage by fertilizers and reducing distances between rows of cotton, bootlegging of cotton in various ways—but such abuses never seriously prejudiced the success of the programme and thus were confounded many sceptics who thought the programme would fail if only for that reason.

It is obvious that cotton farmers as a whole must have been in favour of the programme, notwithstanding their previous experience of the Farm Board's failure. Cotton farmers were in serious difficulties at the beginning of 1933 and were perhaps prepared to try anything, but this is, of course, no explanation of why the control scheme took the form it did. As Mr. Richards shows—and his statements are borne out by the Hearings on the Agricultural Adjustment Act before the Senate and Congress—the leaders of the cotton growing industry as well as the growers generally believed in 1933 that a small cotton crop would sell for a larger amount of money than a large crop, and therefore there was a case for reducing the production of cotton, and they believed also that the demand for American cotton was inelastic and therefore a rise in the price of American cotton would not seriously reduce the sales of American cotton in the United States or in export markets. The experience of the last three seasons must have shaken their belief in these views. It is perhaps a criticism of Mr. Richards's book that it discusses the control scheme of 1933-36 as a whole and cannot, therefore, pay the attention to the changing character of the scheme from one season to the next in so far as it was affected by changing economic and political conditions which a more chronological treatment of the control scheme would have permitted.

The book is one of six studies published by the Brookings Institution on the programmes adopted for different commodities under the Agricultural Adjustment Act. The publication of the final volume dealing with the broader effects of the Adjustment programme will be awaited with considerable interest. H. C.

15.—*Economic Principles of Transportation*. By W. F. Jackman. University of Toronto Press, 1935. 9½" × 6½". 891 pp. \$5.00.

Exactly fifty years ago the Canadian Pacific Railway reached the Pacific Coast and completed one of the greatest links in the chain of Empire communication. It is therefore particularly apposite that Professor Jackman, whose earlier works on *Transportation in Modern England* and *Economics of Transportation* are well known in this country, should now give us an extensive revision of the latter work dealing with the situation created as the result of

the changes which have taken place in economic conditions, and particularly in transport, during the past ten years. During that time, Canada, no less than most countries, has been, and still is, confronted with the problem of establishing a system which will enable its railways to survive the heavy and increasing depletion of their revenues by competitive agencies, and at the same time enable the facilities of road, inland water and air transport to occupy their rightful sphere in the national economy. A unique and by no means helpful factor is the existence of two great railway systems, largely competitive, one privately owned and operated and the other under direct control of the Federal Government. In the first chapter of the present work the development of these lines is traced, and it is evident that their fundamental difference, the well-defined system of the Canadian Pacific contrasted with the aggregation of companies (many of which were formerly competitive), finally brought together in 1923 as the Canadian National, has contributed largely to the turbulent history of the State undertaking. The author next deals with the physical factors, both topographical and technical, involved in the handling of Canada's immense volume of rail-borne traffic. These naturally centre on the economical movement of bulk commodities: it is not uncommon, as Professor Jackman states, to have trains each carrying 1500 to 2000 and more tons of wheat, but much of what is said regarding the maximum utilization of equipment is applicable to this country where the size and variety of consignments bring the average train load to less than 130 tons. An analysis of railway income and expenditure follows, and it is here that the author opens his attack on State management, but one feels that his choice of the "operating ratio" or proportion of operating expenses to gross revenue as a statistical weapon is hardly conducive to the incisive thrust of his argument. He states that "it is generally considered that this furnishes a good guide in normal times to the efficiency of the management of a railway." If this is so, the wide variation in the results of the two Canadian undertakings is indeed significant, but this ratio invariably reminds the reviewer of a statistical student's exercise which affirmed that "if you divide bacon by eggs you merely get algebra." Indeed, the author himself later emphasizes the need for discrimination in its use, and utters a warning against generalization without careful study of all the factors involved. But of the chapters which comprise the section of this volume dealing with the principles and practice of railway rates and charges, illustrated by the rate structure of Canada and the U.S.A., it can only be said that they exemplify the penetration and patient industry which Professor Jackman's earlier works have led us to associate with him. This aspect is often treated by a mere restatement of principles, but the author emphasizes the largely empirical nature of rate construction and the necessity for constant adaptation of the charges to changes in commercial and industrial conditions, and describes the machinery by which the North American railways keep in touch with the various interests and maintain their relationship with the traders and the public generally. Flexibility of rates is particularly necessary in areas undergoing

development, but we are reminded that there is no inconsistency between experimental rate-making and the application of the sciences of economics and mathematics to the experiments themselves. In discussing the influence of freight rates upon prices, the author removes many misconceptions, and shows that there are few commodities where the charge for carriage is other than a relatively small factor in the marketing cost, even when the numerous special services such as refrigeration, cartage and storage are provided in addition to the actual transit. A further chapter discusses the collection and delivery of package freight by the separate agencies of Express companies, and although this is briefly contrasted with the practice in this country under which these consignments are handled throughout by the railway companies themselves, one would have liked the author's views on the relative economy of the two systems, particularly as the collection and delivery service, separately considered, shows heavy debit balances in the accounts of the British Companies.

Government regulation of the Canadian railways is exercised through the Board of Railway Commissioners, the constitution and jurisdiction of which are fully considered. The non-political nature of this body appears to enable it to base its decisions solely upon sound judgment, and appeals to higher authority are rare and seldom sustained. The author concludes that the Board has been of untold service to all interests, including the railways, and contrasts it with the Interstate Commerce Commission of the United States, where regulative tribunals in the individual states lead to difficulties in harmonising provincial and federal interests. The author stresses the need for international control of rates for commodities which move across the border, and reviews the many suggestions which this question has produced. He concludes that the issue might best be solved by co-operation between the tribunals of the two countries.

The section dealing with Government ownership analyses the financial structure of the National Company and its components. The enormous debt burden and precarious financial condition were attributed by the Royal Commission of 1931 to "the red thread of extravagance" in administration, and the author's customary vigour is much in evidence in his discussion of the legislative action which followed the Commission's report. Its requirement that the Canadian National and Canadian Pacific should co-operate for the elimination of waste whilst retaining liberty of competition, is described as "largely a fatuous conception of the mind." Professor Jackman dismisses the possibility of amalgamation and favours unified operation under private ownership, with the abandonment of thousands of miles of duplicate track and a division of the net income between the two companies.

The work concludes with chapters on inland waterways and highways. The former constitute an element of competition with the railways which is almost negligible in this country, and the author considers that there is no justification for the proposed development, jointly with the United States, of the St. Lawrence, which he estimates would cost the country not less than \$335,000,000.

The highway problem has many features in common with that of this country, and Professor Jackman reviews favourably the British legislation for the control of road transport. His recommendations closely follow the provisions of the Acts of 1930 and 1933, and a regulative board is proposed to consist of three competent members who would determine their policy in co-operation with the Railway Commissioners. By this means it is anticipated that, in due course, road transport would fulfil its true function as an agency "auxiliary and complementary to the railways."

One would venture the suggestion that the inclusion of a map of Canada's railways and waterways would facilitate the study of future editions of this important and authoritative work. H. G. L.

16.—Other New Publications.

Bouniatian (Mentor). Dépression, progrès technique et dévaluation.
Paris: Librairie Générale de Droit et de Jurisprudence, 1935.
9" × 5½". 121 pp. 16 fr.

[This book consists of three separate essays. The two first, "La dépression et ses causes" and "Les progrès techniques et le chômage," appeared in the *Revue Internationale du Travail*, the third, as "Dépression und Geldabwertung," in the *Zeitschrift für Nationalökonomie*. All have been revised, and together they form a study of depression and its causes, which the author puts forward for consideration by those concerned to find a cure. His first care is to show that the depression which followed the slump was a distinct phenomenon with its own causes, among which he emphatically refuses to place technical progress. He is equally certain that neither restriction of production (save in very special instances and temporarily) nor devaluation can have any remedial effect. None the less he speaks of the departure of this country from the gold standard as a devaluation deliberately planned to secure an improvement of the economic situation at the expense of the gold standard countries. The three essays remain separate, and there is no summary of general conclusions; but it is plain from the analysis in the first of them that M. Bouniatian would prescribe a greater elasticity of wages as the principal means of counteracting depression and unemployment, the emphasis being placed on the necessity that the rates should rise during the ascending phase of the cycle in correspondence with rising prices and the increase in productive capacity. The whole of the argument is carefully and closely reasoned and lucidly set down, with references and quotations which show the extent of the author's studies.]

British Association for the Advancement of Science. *Mathematical Tables Vol. V. Factor Table giving the complete decomposition of all numbers less than 100,000.* Prepared independently by J. Peters, A. Lodge, E. J. Ternouth and E. Gifford, and collated by the British Association Committee for the Calculation of Mathematical Tables. London: British Association, 1935. 11" × 9¼". xv + 291 pp. 20s.

[The British Association has utilized a bequest by Lt.-Col. A. J. C. Cunningham to publish three volumes in this series. It is obvious that this volume, containing a table giving the factors of all numbers less than 100,000, must be of value to many besides mathematicians. A list is given of existing works, with any errata ascertained, which were consulted in the preparation of this volume. There is also a bibliography of tables of factors of numbers and prime numbers in ranges above

100,000, and as some of them are rare, a list is given of the libraries in this country where they may be found. The Committee express their appreciation of Dr. Comrie's share in the preparation of the work, and it must be observed that not only his labour, but also that of the other collaborators was voluntary.]

Federici (Luigi). Sanzioni. Torino: G. Einaudi, 1936. $8\frac{3}{4}'' \times 6\frac{1}{2}''$. 173 pp. 12 lire.

[This book, published in January of this year, is a study of the effects of the economic sanctions applicable according to Article 16 of the League Covenant and of those actually applied to Italy in 1935. In the first two chapters the author examines the nature of the sanctions and the effects which should, theoretically, result from their application; in the third he discusses the way in which these effects may be modified in a country possessing the especial advantages for resistance conferred by a "controlled national economy." The fourth chapter is a detailed account of the effects on Italian economic life of the sanctions applied and of the measures taken to counteract them; comparative tables show the changes in the quantity, value and direction of Italian trade, and in the country's gold reserves, etc., down to August, 1935; and the probable results of a more or less prolonged continuance of sanctions are roughly estimated. The fifth chapter considers the cost of the sanctions to the several nations applying them. The appendices give lists of the League countries applying sanctions, partially applying them, and refusing to apply them, and tables of the (normal) principal Italian imports and exports with the countries of origin and destination. Although Signor Federici does not conceal his personal or political view of the application of sanctions to Italy, his survey of their economic consequences appears to have been carried out with the "scientific objectivity" which he claims for it.]

International Labour Office. Studies and Reports, Series B., No. 23. Workers' Nutrition and Social Policy. Geneva (London, P. S. King), 1936. $9\frac{1}{2}'' \times 6\frac{1}{4}''$. vii + 249 pp. 5s. 6d.

[The primary purpose of this report, which is to be regarded in the nature of a preliminary or interim report, is to bring together the data already available on the subject and to elucidate the issues involved. In the light of the objective standards of rational nutrition which the science of dietetics lays down, it concludes that large masses of the population in all countries are inadequately or improperly nourished, and that the greater part of this under-nourishment is the result of inadequate purchasing power. There would, on the other hand, seem to be enough potential agricultural capacity to produce much larger amounts of both energy-yielding and protective foodstuffs. At the same time, it is found that existing capacity is in part unused, in part misapplied, resulting in serious maladjustments not only between the demand for and supply of foodstuffs, but also between the amounts and kinds of foods produced and those that might and could be produced in response to the requirements for a rational diet. This non-use of potential capacity and misuse of some of the existing capacity have been aggravated by recent economic trends but they are due essentially to deeper maladjustments created by changes in agriculture and in world economy. These facts give rise to three major questions of a social-economic character. First, what are the social-economic conditions which account for the discrepancy between ideal dietary requirements and actual consumption on the one hand and between potential productive capacity and actual output of foodstuffs on the other? Second, what effects are changes in dietary habits induced by scientific research likely to have on the production and distribution of foodstuffs, and consequently on agriculture and on the economic structure of different countries? And third, taking the standards of rational nutrition established by medical and dietetic

experts as given, what are the main economic and social factors involved in the realization of these standards and what are the various policies which might promote such realizations? Attention is centred on the third question, chapters being devoted to the problems and factors involved in food prices, to social legislation and its bearing on nutrition, and to public and other agencies, including the Co-operative movement, that have set on foot, and may further advance, methods of improving the nutritional level of the population. An active demand for better foodstuffs is largely conditioned, it is concluded, by the size of the national income and by its distribution, and can be influenced by various measures for redistributing income such as relief, social insurance, direct distribution of food to school children, etc. But many effective ways for improving popular nutrition which are open to the modern State as well as to voluntary organizations are still to be fully explored. The study is a very useful contribution to the rising tide of publications on the subject-matter.]

McGregor (A. G.). The Correct Economy for the Machine Age. 3rd edition. London: Pitman, 1936. $8\frac{3}{4}'' \times 5\frac{1}{4}''$. 353 pp. 6s.

[The second edition of this book was reviewed in Part III of the *Journal* for 1935. In the third the author has made various additions and modifications in order to drive his arguments home with greater force, but the book remains the same in substance.]

Morton, (N. W.) Occupational Abilities. A Study of Unemployed Men. London and Toronto: Oxford University Press, 1935. $8\frac{3}{4}'' \times 5\frac{1}{4}''$. xxvi + 279 pp. \$2.50.

[A variety of well-known psychological tests was used in examining the general mental level, the special aptitudes, and the personal traits of various groups of unemployed men in Montreal, with the object of determining their employability. The results suggest an average level of education and intelligence not far removed from normal, and, contrary to a, perhaps, commonly held opinion, there was a clear absence of a majority of individuals who might be classed as unemployable. Standards of comparison were, however, found hard to come by, and the samples tested consisted only of men who voluntarily presented themselves for study, and, therefore, may not be satisfactorily representative of the total population of the unemployed. Some detailed comparisons are made between different occupational groups, between racio-national categories, and between men on relief and men not on relief. The book includes much statistical analysis of the results, while in addition a set of examples of the original case studies is published in full.]

Reed (John E.). Insurance: a General Text-book. London: P. S. King, 1936. $9'' \times 5\frac{3}{4}''$. 494 pp. 18s.

[A useful work, describing in one volume the essential details of the various classes of insurance business carried on in this country. The basis of the book is the Education Section covering life, fire, accident, and marine insurance contributed by the author to the *Insurance Record* in 1927. These articles proved so useful, not only to students preparing for the Chartered Insurance Institute examinations for whom they were originally intended, but to a much wider circle, that they were continued for several years. Subsequent legislation, such as the Road Traffic Acts of 1930 and 1934, and changes affecting different kinds of business, have necessitated much revision of the original contributions. The book is in eleven parts: life; fire; loss of profits or consequential loss; motor; personal accident; disease and sickness; burglary; fidelity guarantee; public liability; workmen's compensation (including plate glass, engineering, and livestock); marine insurance. The book is easily arranged for reference and well-indexed.]

Report of the Proceedings of the Meeting of Economists held at the Antwerp Chamber of Commerce on July 11, 12, 13, 1935. Antwerp: L. Braeckmans. 10" x 6½". 208 pp. 20 fcs. belges.

[The meeting of Belgian and foreign economists was held on the initiative of the Antwerp Chamber of Commerce. There were fifteen delegates: nine from Belgium, Mm. Ansiaux, Baudhuin, Chlepner, Craen, Deschesne, De Leener, Dupriez, Miry, and the Rév. Père Muller; three from Great Britain, Messrs. R. F. Harrod, H. D. Henderson, and J. M. Keynes; one from France, Monsieur Nogaro, one from Sweden, Monsieur Ohlin; and one from the Netherlands, Dr. Verrijn Stuart. This volume contains the eleven papers, which were circulated in advance, and reports of the discussions which ensued at the meetings. The subjects tabled for consideration were: (1) Monetary Policy and International Trade, and (2) The Future of International Trade. Among the papers submitted were three entitled "La politique monétaire et le commerce international," by Mm. Ansiaux, Chlepner, and Nogaro, respectively, "L'avenir du commerce international," by M. De Leener, "A comment on the questions for discussion," by Mr. R. F. Harrod, "Politique monétaire et avenir du commerce international," by M. Miry, "International trade and monetary policy," by M. Ohlin, and "Quelques remarques concernant la stabilisation monétaire," by Dr. Verrijn Stuart. Messrs. Craen, Deschesne, and Henderson also contributed memoranda. The meeting resulted in the adoption, by a majority of those present which included the three English delegates, of sixteen resolutions. The text of these, and of a statement by M. Nogaro and a note of dissent by Mm. Ansiaux, Deschesne, De Leener, and Miry, is given in French and English. Preliminary drafts and suggested modifications are appended.]

STATISTICAL NOTES.

1. BRITISH OFFICIAL STATISTICS.

On page 818 we give our usual table summarizing the overseas trade of the United Kingdom for the years ended July, 1935 and 1936. The trade of July was remarkable in that exports of United Kingdom goods exceeded £40 million for the first time since November, 1930. The increase of £3·6 million recorded for July compared with a year earlier was in marked contrast to the fluctuating fortunes of earlier months, the net increase for the first half of the year amounting to only £1·4 million. The increase in July took place notwithstanding a fall of £700,000 in exports to Italy, the value of such exports in July being even less than the average of £40,000 for the first half of the year. Not only in exports, but in imports, re-exports and goods transhipped under bond, was there an expansion in July. The increases in imports and re-exports followed on similar movements for the first half of the year. The excess of imports over exports of merchandise in July amounted to £23·7 million. This compares with £21·4 million for July, 1935, and an average of £27·1 million for the first half of this year.

Imports last month were valued at £68,731,000, or £6,967,000 more than in July, 1935. The increase was greatest in respect of raw materials, £3,080,000 or 18 per cent., but imports of manufactured articles, many of which are materials for industry, increased by nearly the same proportion, £2,723,000 or 17½ per cent. The increase for food, drink and tobacco was comparatively small, £957,000 or 3 per cent. Re-exports increased by £1,031,000 to £4,992,000, due essentially to the greater value of the re-exports of wool, non-ferrous metals and rubber.

Retained imports of food, drink and tobacco during July were valued at £28,903,000, or £1,051,000 more than a year earlier. Much the largest increase was in respect of dairy produce, £1,547,000, the increase in imports of butter alone just exceeding £1 million. The latter was primarily due to a rise of 28 per cent. in average values and there was also a marked rise in the average value of the cheese imported and a smaller one for eggs. The other principal change in value was a decline of £856,000 for fresh fruit and vegetables, most of the principal descriptions decreasing in quantity as well as value. The rise of £239,000 for grain and flour resulted from a rise of 22 per cent. in the average value of the wheat imported, other descriptions

of grain and flour, except barley, showing a decline in both quantity and value of the imports. Imports of beef were the same as a year earlier, but those of mutton and lamb and of bacon declined. Average values of beef and mutton and lamb each rose by about 14 per cent. Imports of tea and sugar were smaller, but tobacco continued to be imported in larger quantities than a year earlier.

Raw materials imported and retained increased in value from £15,202,000 to £17,501,000. Raw cotton increased by £1,760,000, the rise in quantity exceeding 80 per cent., while for the year up to date the imports were the highest since 1929. As a result of smaller imports and larger re-exports of wool, the value of the retained imports declined by £906,000, while a similar movement for rubber led to a decline of £592,000. The increase of £1 million for wood and timber was the result partly of imports a year ago being small; substantial rises were also recorded for hides and skins, iron ore and scrap, and oil seeds, oils, etc.

Retained imports of manufactured articles rose from £14,516,000 to £16,961,000. The increase was practically general, only two groups showing declines, not in either case of importance. The largest increases were recorded for iron and steel (£541,000), non-ferrous metals (£431,000), machinery (£393,000), and manufactured oils (£321,000).

The value of United Kingdom goods exported in July amounted to £40,086,000, showing an increase of £3,642,000 on the total for July, 1935. Food, drink and tobacco increased by £424,000 to £3,044,000, due, as in previous months, mainly to larger exports of spirits to the United States and other countries, but exports of manufactured tobacco also increased substantially. Exports of raw materials were valued at £4,591,000, there being for the first time this year an increase, albeit only £17,000, compared with a year earlier. Most of the groups showed increases, but the value of the coal exported declined by £150,000 and the quantity by 319,000 tons (9 per cent.). This decline was due entirely to there being no export of coal to Italy, whereas a year earlier exports amounted to 405,000 tons. Sweden and Denmark in particular took greater quantities of coal, while apart from Italy the only decline in excess of 50,000 tons was recorded for Canada.

Exports of manufactured articles rose from £28,400,000 to £31,493,000, and this increase was spread over practically all groups. Only two of the nine groups for which a decline in value was recorded for the first half of the year showed a decline in July, viz. non-ferrous metals (£273,000) and manufactured oils (£106,000). There was in

Movements and Classes.	Twelve Months ended 31st July, 1933.	Twelve Months ended 31st July, 1936.	Increase (+) or Decrease (-).			
Imports, c.i.f.—	£'000.	£'000.	£'000.			
Food, drink and tobacco	347,721	370,103	(+) 22,382			
Raw materials and articles mainly un- manufactured	211,709	232,327	(+) 20,618			
Articles wholly or mainly manufac- tured	175,859	200,142	(+) 24,283			
Other articles ...	3,695	5,095	(+) 1,400			
Total Imports ...	738,984	807,667	(+) 68,683			
Exports, f.o.b.—						
<i>United Kingdom produce and manufactures—</i>						
Food, drink and tobacco	30,155	34,055	(+) 3,900			
Raw materials and articles mainly un- manufactured	51,280	50,784	(-) 496			
Articles wholly or mainly manufac- tured	321,938	333,327	(+) 11,389			
Other articles ...	12,438	12,848	(+) 410			
<i>Imported merchandise—</i>						
Food, drink and tobacco	12,167	11,891	(-) 276			
Raw materials and articles mainly un- manufactured	27,449	31,396	(+) 3,947			
Articles wholly or mainly manufac- tured	10,764	16,458	(+) 5,694			
Other articles ...	316	324	(+) 8			
Total Exports ...	466,507	491,083	(+) 24,576			
Bullion and Specie—						
Imports ...	258,895	246,588	(-) 12,307			
Exports ...	152,096	149,738	(-) 2,358			
Movements of Shipping in the Foreign Trade—	Number of Vessels.	Thousand Tons Net.	Number of Vessels.	Thousand Tons Net.	Number of Vessels.	Thousand Tons Net.
<i>Entered with cargoes—</i>						
British ...	24,188	35,737	24,234	36,993	(+) 46	(+) 1,256
Foreign ...	24,505	26,801	25,657	28,809	(+) 1,152	(+) 2,008
Total entered ...	48,693	62,538	49,891	65,802	(+) 1,198	(+) 3,264
<i>Cleared with cargoes—</i>						
British ...	28,792	33,917	29,127	34,174	(+) 335	(+) 257
Foreign ...	21,150	22,869	21,019	22,646	(-) 131	(-) 223
Total cleared ...	49,942	56,786	50,146	56,820	(+) 204	(+) 34

addition a decline of under £500 for manufactures of wood and timber. Of the other groups for which a decline in value had previously been recorded, striking increases were recorded in July for cotton yarns and manufactures (£488,000), vehicles (£374,000), iron and steel (£271,000) and chemicals, etc. (£123,000). Among the groups for which increases had been recorded earlier in the year there was a marked increase in July in respect of machinery (£530,000), woollen and worsted yarns and manufactures (£438,000), miscellaneous manufactures (£408,000) and manufactures of miscellaneous textiles (£279,000). The increase in the cotton group resulted from an all round expansion in exports of cotton goods, piece goods showing the first increase since July, 1935. The increase was spread over a number of markets, but exports to India continued to be substantially less than a year earlier. The increase in iron and steel goods was nearly general; railway material continued to show a substantial improvement, and there was an important decline only for wrought tubes. The increase in the vehicles group was also the result of a practically all round expansion. Exports of aircraft declined in value, but increases were recorded for locomotives, ships, motor-cars and chassis, motor-cycles, other cycles and rubber tyres and tubes.

Imports of bullion and specie during July amounted to £43·5 million, an exceptionally high figure resulting from the importation of gold valued at £28·9 million from France. Exports were small, being only £3·8 million. The excess of imports during January-July amounted to £107 million, which was £41 million more than in the corresponding period of 1935.

There was a fairly steady rise in general *wholesale prices* during the two months June and July, 1936, and the Board of Trade Index Number showed an advance of 1·8 per cent. over the period. Prices of articles of food have risen 1·9 per cent. and of industrial materials and manufactures 1·8 per cent. Most groups of articles showed some advance, which was largest in cotton 8·1 per cent. and in iron and steel (3·2 per cent.). There was a slight decline in the prices of wool (1·8 per cent.) and of non-ferrous metals (1·4 per cent.), and the prices of other textiles generally showed no change.

Compared with twelve months ago, the rise in prices was general to all groups, and those for July, 1936, showed an advance of 6·2 per cent. over those for July, 1935. Food prices have advanced during the year 5·8 per cent. and materials and manufactures 6·5 per cent.

Cereals are 11.1 per cent. higher in price, wool 9.2 per cent., iron and steel 7.8 per cent., and cotton 7.1 per cent. General wholesale prices are now higher than at any time since November, 1930. Taking the years 1930-36, general prices are now 13.2 per cent. above the lowest point (82.7) reached during the period (March, 1933). Apart, however, from the iron and steel group, wholesale prices in July, 1936 are still below the level of those obtaining at the beginning of 1930, and in most groups very considerably below that level.

The index numbers for the last three months are given below.

Averages for the year 1930 = 100.

	Total Food.	Total not Food.	Total.	Basic Materials.	Inter- mediate Products.	Manu- factured Articles.	Building Materials.
May 1936 ...	88.2	93.8	91.9	96.1	91.1	96.9	95.0
June „ ...	89.3	94.3	92.6	95.9	91.5	98.1	96.1
July „ ...	89.9	95.5	93.6	97.4	93.5	98.8	96.9
July 1935 ...	85.0	89.7	88.1	88.1	87.5	94.7	93.8
„ 1934 ...	84.3	89.0	87.3	87.1	86.0	94.8	92.3
Lowest re- corded in 1930-36 ...	80.7	80.8	82.7	63.1	81.4	91.0	91.2
Date of Low- est Record	Mar. 1933	June 1932	Mar. 1933	June 1932	June 1932	Sept. 1931	Mar. & April 1933

There was some slight increase in the *cost of living* in working-class families during June and July, 1936, due to advances in the retail prices of cheese, eggs, butter, flour and bread. Some of these changes are partly seasonal, but on the whole they seem to be indicative of a somewhat earlier approach to the higher prices usually prevailing in autumn and winter. The prices of bacon remained high, due no doubt to a considerable extent to a somewhat short supply, and the quantity allowed to be imported has been increased of late. The index number of retail prices of articles of working-class consumption prepared in the Ministry of Labour rose from 144 (level of prices at July, 1914 = 100) at the beginning of June to 146 at the beginning of July, and was at the same level at the beginning of August. The index number for articles of food only rose from 126 at June 1st, to 129 at August 1st, the cost of rent, fuel, clothing and other items remaining unaltered. The numbers (146 and 129) are higher than for any August since 1930.

There has been a continuous improvement in *employment* since the end of January, 1936, and the number of unemployed persons

on the registers of the Ministry of Labour Employment Exchanges in Great Britain at the end of July was 1,652,072, or a decline of 507,650 since the end of January when employment is generally lowest, and of 320,869 as compared with July, 1935. The number unemployed is now less than at any time since March 24th, 1930. As persons employed in agriculture are now insurable, and also young persons in the insured trades between the ages of 14 and 16, it is probable that the numbers in these two last-mentioned categories are more completely registered, and the actual amount of unemployment is somewhat more favourable as compared with the spring of 1930 than the figures would appear to indicate. The rate of unemployment in the insured trades (excluding agriculture) in Great Britain and Northern Ireland was 12.7 per cent. at the end of July, 1936, compared with 13.1 per cent. at the end of June, 13.0 per cent at the end of May and 16.3 per cent. at the end of January. At the end of July, 1935, the percentage unemployed was 15.3. Employment in the engineering trades is fairly good on the whole, and is good in the motor, cycle, and aircraft industry. It is fair generally in the remainder of the metal trades, with the exception of the shipbuilding, tinplate, and tube industries. In eight important industries, however, covering 1,800,000 workpeople the rate of unemployment is above 20 per cent., ranging from 22.3 per cent. in the shipping service to 43.2 per cent. in public works contracting. In this last-named industry the rate of unemployment has been continuously above 40 per cent. for some years.

The total number on the registers of employment exchanges in Great Britain for the last three months are given below.

Date.	Wholly Unemployed.	Temporarily Stopped.	Persons normally in Casual Employment.	Total.
May 25th, 1936 ...	1,397,755	225,285	82,002	1,705,042
June 22nd, ,, ...	1,326,057	301,793	74,826	1,702,676
July 20th, ,, ...	1,285,805	296,007	70,260	1,652,072
July 22nd, 1935 ...	1,501,226	393,198	78,517	1,972,941
March 24th, 1930 ...	1,135,768	407,429	95,602	1,638,799

The number of boys and girls between the ages of fourteen and sixteen on the registers at July 20th, 1936, was 49,873 (23,947 boys and 25,926 girls).

Births. From the Quarterly Returns of the Registrar-General published in respect of the first and second quarters of 1936, the live births registered in England and Wales during the six months, January to June, 1936, may be ascertained as provisionally number-

ing 305,836. corresponding to an annual rate of 15.0 per thousand for the half-year. The similarly calculated rates for the corresponding first halves of the years 1935 to 1932 were 14.9, 15.1, 15.0 and 15.8 respectively, from which it will be observed that though this year's figure is fractionally higher than that of last year, it is not significantly different from either of those of the past three years. The maintenance of the rate at an approximate level over like periods within a span of four consecutive years has not previously been reported for many decades, and the recurrence of each similar record adds further support to the indication that the particular phase of rapid birth rate decline associated with post-war conditions came to an end soon after the commencement of the current decade, and is now being succeeded by a period giving greater promise of stability, though at a level far lower than that to which we have been accustomed in the past, either in this country or elsewhere.

Marriages in the first half of 1936 are reported as numbering 149,937, corresponding to an annual rate of 14.7 persons married per 1,000 population for the half-year. The rate compares with the similarly calculated figures of 14.7, 14.2, 12.9 and 13.1 per 1,000 for the corresponding halves of the years 1935 to 1932 respectively, the comparatively high level of last year being thus continued into 1936.

Deaths in England and Wales registered during the first two quarters of 1936 numbered 273,140, nearly 20,000 in excess of the corresponding figure of last year. In relation to the population exposed to risk, the number corresponds to a crude annual death rate of 13.4 per 1,000 and compares with 12.6, 13.1, 13.8 and 13.5 for the first halves of the years 1935 to 1932. In late years the bulk of the variations in the year's deaths have arisen from fluctuations in the first quarter's figures from which it may be expected that the incidence of deaths in 1936 as a whole will be above, rather than below, the average of recent years.

The recent publication of the Life Table section of the Registrar-General's Decennial Supplement, 1931, adds another link to a chain of long-range comparative mortality indexes, dating back to the earliest days of death registration in this country. The main object of the latest addition is the presentation of English Life Table No. 10, which expresses in life-table form the mortalities experienced by males and females in England and Wales during the three years 1930-32, and which, by its similar form and construction, is directly

comparable with its two immediate predecessors, English Life Tables Nos. 9 and 8, dealing with the mortalities of the periods 1920-22 and 1910-12 respectively. So far as the basic mortality record is concerned, the changes disclosed for the successive periods, viz., a substantial improvement in vitality at all ages up to late middle age, with particular reference to the periods of infancy and active adult life, followed by a general absence of improvement at the oldest ages, are in no sense different from those which have been regularly discussed in the Registrar-General's Annual Review and interest in the tables—apart from their specific actuarial application—will be directed to the more characteristic life-table functions like the expectation of life, summarized comparisons of which are given in the following table, or its reciprocal which gives the life-table death rate.

Expectation of Life (Years).

Age.	Males.			Females.		
	E.L.S. 1910-12.	E.L.9. 1920-22.	E.L.10. 1930-32.	E.L.8. 1910-12.	E.L.9. 1920-22.	E.L.10. 1930-32.
0	51.50	55.62	58.74	55.35	59.58	62.88
20	44.21	45.78	46.81	47.10	48.73	49.88
40	27.74	29.19	29.62	30.30	31.86	32.55
60	13.78	14.36	14.43	15.48	16.22	16.50
80	4.90	4.93	4.74	5.49	5.56	5.46

The life-table death rate (all ages) has fallen between 1911 and 1931 from 19.4 to 17.0 per 1,000 in the case of males and from 18.1 to 15.9 per 1,000 in the case of females, and the percentage declines thus recorded, namely, 12.4 and 12.2 per cent. for males and females respectively, may be contrasted with the much larger falls of 25.5 per cent. and 28.8 per cent. shown for the same period by the more familiar standardized death rates based upon the standard 1901 population.

In addition, the volume contains a life table for the area known as Greater London, and also provides some useful comparative tables showing the varying incidence of mortality in geographical regions within the country. The separate experiences of single, married and widowed females are also discussed, and graduated rates of mortality provided in a form comparable with the q_x of the normal life table.

The *Ministry of Transport* returns of the capital, traffic, receipts and expenditure of Railway Companies in Great Britain during 1935 show a general if relatively small improvement upon the

position in 1934. Net revenue rose by £1,440,162 or 4·46 per cent. to £33,695,058 which, together with profits from realization of investments and appropriations from reserves enabled an average return of 3·05 per cent. to be paid upon the issued capital as compared with 2·94 per cent. in the previous year. Nevertheless, over £271,000,000, or practically one-quarter of the issued capital of the four principal systems, again went unremunerated, and a good deal of ordinary and deferred stock has received no payment since 1930.

Extensions to existing works together with additions and improvements to rolling stock account for an increase in capital outlay of £2,183,270, the expenditure having reached £1,180,098,460, whilst capital receipts have increased by £501,389 to £1,116,532,097, the excess expenditure being met by internal investment of renewal and pension funds, savings bank deposits, etc.

Revenue expenditure has risen by £1,153,390 or 0·79 per cent. to £148,304,741, the cost of railway working having advanced by £626,800. Additional services have added considerably to the outlay on "way and works," locomotive running and traffic expenses, these having cost £1,395,023 more than in the previous year, but this is offset by reductions of £237,983 in local rates and £746,420 in payments to the Freight Rebates Fund set up by the Derating Act of 1929 for the purpose of affording relief to the heavier traffics. The expenses of ancillary services such as steamboats, docks, hotels and goods road transport have risen by £526,590, an interesting item being that of air transport which cost £60,430 or more than double the 1934 figure.

Gross receipts show an increase of £2,672,227 or 1·52 per cent. to £179,233,350. The takings of the purely railway services were £2,130,972 higher, to which passenger traffic contributed £1,360,969 and goods and miscellaneous services £770,003 representing increases of 1·98 per cent. and 0·89 per cent. respectively. Although no doubt welcome to the undertakings, these figures show a considerable retardation in the rate of recovery, being much less than the corresponding increases of 1934 over 1933. There were, however, over 31 million more passenger journeys than in 1934, this figure at 1,231 million having practically reached the 1930 level. Goods tonnage, at 270,877,672, is very little higher than in the previous year and is still about 10 per cent. below that of 1930.

The ratio of expenditure to receipts fell from 81·49 to 80·79, and the operating statistics reflect considerable economies. The mileage worked by locomotives rose by 8,408,000 to 566,052,000, but a reduction of 172 in the number of motive units in use was effected by increasing the average mileage per day from 108·12 to 110·08, a figure never previously reached since comparable statistics have

been available. 52.42 lbs. of coal per engine-mile were consumed by steam locomotives as against 52.37 lbs. in 1934. The average speed of passenger services, at 14.99 train miles per train hour (including stationary time) is also a record having continuously improved over the past ten years. A slight decrease in the corresponding figure for freight trains from 9.32 to 9.31 train miles per hour is accounted for by an increase in the average net train load from 125.27 tons to 125.98 tons. Increased efficiency in the operation of freight traffic as a whole is demonstrated by an advance in the ton-miles worked per engine hour from 459.92 to 463.43.

The position up to the end of April, 1936, is summarized in Return No. 197 of the Ministry's "Railway Statistics." In the four months 260,660,000 passenger journeys (excluding those of season-ticket holders) were undertaken over the systems of the main-line companies and 137,595,000 on the railway section of the London Passenger Transport Board's system. These figures represent increases over the corresponding period in 1935 of 8,544,000 or 3.4 per cent. and 9,951,000 or 7.8 per cent. respectively, but this is partially due to the extra weekday (February 29th) in the current year. Passenger receipts rose by £547,000 or 4.7 per cent. to £12,245,000 and those of London Transport by £135,000 or 7.4 per cent. to £1,826,640. First-class travel, although only slightly more than one per cent. of the total, shows a fairly substantial increase. In the case of the main-line companies, 86 per cent. of the revenue was derived from fares below the standard, and the average receipts per journey were 0.28*d.* higher at 13.78*d.* Season tickets produced £855,000, remaining at practically the same level as last year. Reductions in rates lowered receipts from parcels, milk and miscellaneous traffic by £33,750 or 3.0 per cent. to £1,075,200.

In the first sixteen weeks of the year, 88,900,000 tons of freight were carried, an increase of 2,204,000 tons or 2.5 per cent. This produced £27,908,000 or £934,000 (3.5 per cent.) more than in 1935, an encouraging item being the coal traffic which advanced by 5.8 per cent.

The additional expense of transporting the heavier traffics is reflected in the operating statistics, coaching engine mileage having risen by 2.6 per cent. to 99,321,000 and freight engine mileage by 3.6 per cent. to 79,255,000. Higher traffic density is also probably responsible for slight decreases in average train miles per train hour, the figure for coaching trains being 0.06 lower at 15.09 and that for freight 0.81 down at 8.54. The average freight train load was, however, 3.0 per cent. higher at 130.30 tons but the slower rate of

movement reduced the ton-miles per engine-hour from 463·73 to 453·21.

The upward trend in gross receipts continues, the position up to 5th September being as follows :—

			Receipts.	Increase on 1935.	
			£	£	Per cent.
Great Western	...	...	18,045,000	421,000	2·4
L.M.S.	...	...	43,741,000	1,668,000	4·0
L.N.E.	...	...	31,628,000	1,044,000	3·4
Southern	...	...	14,640,000	212,000	1·5
<i>Total</i>	...	...	108,054,000	3,348,000	3·2

The index number of the *prices of agricultural produce* in England and Wales as calculated by the Ministry of Agriculture for the period known as the "harvest year" showed an increase in the twelve months, September, 1935, to August, 1936, the figure being 120 as compared with 115 in 1934-35. If allowance is made for "deficiency payments" under the Wheat Act, 1932, and the subsidy under the Cattle Industry Act, 1934, the index for 1935-36 is raised by 5 points to 125, as compared with 121 in the previous year.

The upward movement was due in the main to increases in the average prices of wheat, fat cattle, milk, butter, cheese, eggs, potatoes, fruit, vegetables and wool, which more than offset the effect of reductions in the prices of oats, fat sheep, pork, pigs and hay. Average prices of barley, bacon, pigs and hops were about the same as those ruling in the previous year.

In the following table, the figures of the general index for the past six years are given, together with the index as adjusted to allow for the inclusion of the additional payments referred to above. (base 1911-13 = 100).

	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36
	123	114	106	113	115	120
Adjusted	...	—	110	117	121	125

It will be seen that the adjusted index for 1935-36 was at the same level as the general index for 1930-31

2. OTHER STATISTICS.

The International Institute of Agriculture has recently issued the sixth volume of its series of Economic Commentaries on the International Year Book of Agricultural Statistics (*The World Agri-*

cultural Situation in 1934-35. Price 25 lire). A large portion of this volume is devoted to a description of the Government measures of Farm Relief, and the economic conditions of agriculture in the principal countries of the world. To those who wish to know something of the position in any individual country, this section should prove of great value.

Another useful chapter is devoted to notes on the market conditions of the main agricultural products, *i.e.* cereals, sugar, coffee, tea, olive oil, wine, tobacco, textiles, live stock, and live-stock products. These notes give the main figures of production and distribution, while the movements of prices are expressed in the form of index numbers.

In the introductory portion of the volume a praiseworthy effort is made to analyse the outstanding changes which are taking place in the world agricultural situation. A number of interesting observations are made, but the conditions in the various countries, as a consequence of national planning and a desire for self-sufficiency, are now widely divergent, and it is becoming increasingly difficult to view as a unit what is, in reality, a number of separate compartments.

The index numbers of wholesale prices in Great Britain prepared by the *Economist*, the *Statist*, and *The Times* showed a rise in general prices of 2.7, 1.9 and 2.5 per cent. respectively as between the end of May and the end of July, 1936, and the advances were common both to the food groups and the industrial materials groups, though not to the extent. Compared with the end of July, 1935, the rise in general prices was somewhat more considerable, being 5.3, 3.0 and 4.6 per cent. The official index numbers of wholesale prices for France, Germany and the United States are given below, together with those of the four principal British index numbers, the average prices for 1913 being taken as 100 for all the index numbers except that of the Board of Trade, in which the average prices for 1930 =

Date.	Board of Trade.	<i>Economist</i> .	<i>Statist</i> .	<i>The Times</i> .	France (<i>Stat. Générale</i>).	Germany (<i>Stat. Reichsamt</i>).	United States (Bureau of Labour).
May 1936	91.9	96.0	100.2	105.0	377	103.8	112.4
June "	92.6	96.6	99.3	105.5	372	104.0	112.7
July "	93.6	98.6	102.1	107.6	388	—	—
July 1935	88.1	93.7	99.2	102.9	334	101.8	113.4
" 1934	87.3	91.0	96.9	99.6	361	98.9	107.2

The value of *Stock Exchange Securities* showed some slight appreciation during June and July, 1936, owing to an improvement in variable interest group, fixed interest stocks not showing any noticeable change. In the index number prepared by the *Bankers' Magazine* variable interest securities rose from 124.8 in May to 126.1 in July, 1936, and fixed interest stocks moved from 131.1 to 131.0, while the total index number for the whole 365 representative stocks increased from 129.1 to 129.4 (values at December, 1921 = 100). This increase (0.3) represented a gain of £20,260,000. Home Railway Stocks both ordinary and preference showed some advance, and United States Railway Shares improved considerably, while iron and steel shares continued to improve appreciably. The high prices of British Government stocks have been generally maintained. Variable interest securities generally have appreciated rather more than 9 per cent. since July, 1935.

The index numbers for the last three months are given below.

Date.	Fixed Interest Stocks.	Variable Interest Securities.	Total.
May 19th, 1936	131.1	124.8	129.1
June 19th, „	130.6	125.1	128.8
July 20th, „	131.0	126.1	129.4
July 22nd, 1935	131.5	115.6	126.4

According to the index number prepared by the Chamber of Shipping, there was not any considerable improvement in shipping-freight rates during June and July, 1936, although the prices ruling were appreciably above the low rates obtainable in February, 1936. Since July rates have strengthened somewhat, particularly in the Argentine and North American trade. The number for July, 1936 (1920 = 100) stood at 20.69 compared with 20.56 in June and 18.58 in July, 1935. Rates are still nearly 17 per cent. below the level of 1929.

Statistics of *retail sales* in Great Britain (prepared by the Bank of England in collaboration with the Retail Distributors' Association and other associations of retailers, including the Co-operative Societies) show that there was an increase in the value of sales in the six months February to July, 1936, of 6.3 per cent. over the sales in the corresponding six months of 1935. Sales of food increased 8.5 per cent. and other kinds of merchandise 3.9 per cent. In the London area (Central, West End and Suburban) total sales increased

5.1 per cent. and in the rest of Great Britain 6.8 per cent. The index numbers for May, June and July, 1936, were 118, 114 and 115 respectively (average daily sales in 1933 = 100).

Employment in the Irish Free State improved to some extent during the last two months, and was better than in 1935. The number on the registers at Employment Exchanges at the end of July, 1936, was 68,959, compared with 82,371 at the end of July, 1935. During the summer months of both years there were restrictions excluding from unemployment assistance certain classes of workpeople living in rural areas.

Employment in Germany continued to improve, and the number of workpeople recorded as unemployed fell to 1,170,000 at the end of July, 1936, a reduction of about 584,000 compared with July, 1935. It is not quite clear, however, to what extent persons engaged in voluntary labour services and in relief works are excluded from the figure. Of the 1,170,000 unemployed, 183,600 are on poor-relief and 662,800 are in receipt of Standard or Emergency unemployment benefit. In France employment shows very slight improvement, and appears to have been hardly as good in June and July as twelve months previously. In Belgium there was some reduction of late in the number unemployed, but in Holland employment was slack. In the Scandinavian countries there was a seasonal improvement in the early summer, but employment on the whole was not good. In Austria, Poland and Czechoslovakia employment, though still somewhat depressed, has shown a marked improvement. In the United States employment has not improved very rapidly during the last few months, but the usual seasonal falling off in July was not apparent. For the three months May to July, 1936, the returns of the American Federation of Labour show the proportion of its members out of work as 17 per cent. In Canada employment improved during the first half of the year, and in Australia and New Zealand it is on the whole better than in 1935, although there is room for considerable improvement.

CURRENT NOTES.

NUTRITION has always been a concern of doctors, but in recent years we have come to see its economic and, therefore, its statistical importance. The depression has shown us in massive form the connection through food of poverty with productive capacity, and the suspicion has grown to a certainty that a large, though undefined, section of the population of every country is receiving much less than the nourishment appropriate to reasonable well-being. The conclusion is, on the one hand, that the productive capacity of any nation is much below what it could be, and, on the other hand, that, if the depressed classes could obtain the necessary purchasing power, the increased demand for food would regenerate the agricultural industries and, consequently, would have important indirect effects on the manufacturing industries. Against this the spread of machine-work and sedentary occupations with lower demand on energy reduces the demand for food. The habit of taking food away from home changes marketing conditions. For these and many other reasons it may be useful to draw the attention of Fellows to a few authoritative publications on the subject.

Since 1925 the Health Organization of the League of Nations has been engaged in the study of nutrition in relation to public health, and has published a number of valuable reports. The principal of these is *Nutrition and Public Health*, by Dr. E. C. Burnet and Dr. W. R. Aykroyd (Allen and Unwin, 1935; 152 pp., 2s.), a comprehensive survey, treating of nutritional standards, food supply, education in nutrition, and public health and nutrition work. In 1935 a Technical Commission was set up and a "Mixed Committee on the Problem of Nutrition," under the chairmanship of Lord Astor, was appointed to co-ordinate the work of the Health Organization, the International Labour Office, and the International Institute of Agriculture. This Committee has now issued its *Interim Report* (Allen and Unwin, 1936; pp. 98, 2s. 6d.), and the *Report on the Physiological Bases of Nutrition* prepared by the Technical Commission (or "London Committee"), has been published as Part II (27 pp., 6d.) of the Mixed Committee's Report. Parts III of that Report, *Nutrition in Various Countries* (271 pp. 5s. 6d.), and IV, *Statistics of Food Production, Consumption, and Prices* (110 pp., 3s.), have just appeared. Part I covers much of the ground of the Burnet-Aykroyd Report, with special sections on "Nutrition and Labour" and "Nutrition and

Agriculture." The London Committee lays down what, we hope, will be universally accepted as final standards for an optimum diet under various conditions. Part III surveys the nutritional position in many countries and the means taken to combat malnutrition. The duty of economists and statisticians is to accept the technical conclusions of the physiologists and doctors and, by applying them to the local conditions of any nation, to assess their effects on the measurement of public welfare. Almost every page of the documents quoted calls for further economic enquiry and statistical investigation. For example, among fifteen recommendations of the Mixed Committee, we select these, "that Governments should: (6) Consider what steps should be taken, whether at the public charge or otherwise, to meet the nutritional needs of the lower-income sections of the community, and, in particular, the means by which they might ensure that adequate supply of food, especially safe milk, should be made available for expectant and nursing mothers, infants, children, and adolescents. . . . (11) Consider whether any modification of their general economic and commercial policy is desirable in order to ensure adequate supplies of foodstuffs, and, in particular, to assist the re-orientation of agricultural production necessary to satisfy the conditions of sound nutrition." To take a minor point—to increase the supply of milk a much larger dairy-herd is required and, consequently, a much larger supply of cheap but inferior cow beef will in due course be brought to market; what effect should this have on our beef policy? Again, it will no longer be sufficient to apply an average of 3,000 calories per man per day in order to estimate the nutritional requirements of our population and the sufficiency of our food supplies; it will be necessary to build up a total out of the requirements of different areas and separate occupations. There is going to be plenty of work for the statistician in revising old and making new estimates.

Fellows will be by now familiar, at least through the Press, with the main features of Sir John Boyd Orr's *Food Health and Income*, (Macmillans, 1936; pp. 72, 2s. 6d.), which is further described on the title page as "Report on a Survey of Adequacy of Diet in Relation to Income." With the help of information furnished by the Market Supply Committee, he has endeavoured "to give some idea of the diets and of the standards of health attained in different sections of the community." The task involved a classification of the population by income groups, and the estimates, though rough, may perhaps be accepted as reasonable. More is not and cannot be claimed, for we do not know sufficiently the distribution of families

by size and number of earners, nor do we know the distribution of working-class earnings, statistics of weekly wage-rates on full time being notoriously incomplete and deceptive. Sir John is very cautious in his conclusions, and only says: "If these findings be accepted as sufficiently accurate to form a working hypothesis, they raise important economic and political problems." It is, indeed, highly probable that better information would only slightly modify the graphs on pp. 25-28, showing by income groups the estimated consumption of certain foodstuffs per head. Careful reading of the book in conjunction with the League of Nations publications referred to above will indicate to Fellows the kind and quantity of the work that has to be done, and it is to be hoped that there will be plenty of volunteers for the task. Sir John has drawn a picture, the broad outlines of which are certainly true, and it requires now to fill in the details. No statistician, no economist, no politician can afford to stand idle if there is the remotest chance of the picture being real, and, as something must be done pending the slow accumulation and analysis of new facts, the "working hypothesis" may be accepted as a basis for immediate policy.

In view of the approaching decennial revision of the *International Lists of Causes of Deaths*, a survey of the present situation is made in a recent number of the League of Nations Epidemiological Reports (1936, 426, pp. 49-70). Tabulations are made of the extent of the adoption of an International List in the various countries of the world, of the nomenclature used in each and of the sub-divisions of causes used or omitted. A second table shows the age-groupings adopted in different countries in publishing mortality data, whether absolute figures or rates, or both, are published for sex and age-groups, whether standardized death rates are calculated, and the degree of detail with which infant mortality is studied. In spite of the progress that has taken place there is still much to be achieved before a common nomenclature will allow international comparability. The Report should clearly be of value to those who wish, in spite of the difficulties, to embark upon international comparisons of death rates by causes.

The current number of the *Journal of Hygiene* (Vol. xxxvi, No. 3, August, 1936) contains two papers of value to those interested in vital statistics, both coming from Professor Greenwood's department of Epidemiology and Vital Statistics in the London School of Hygiene and Tropical Medicine. One, by Mr. W. J. Martin, is an analysis of the declining birth rate in Wales and South England

and forms an extension of Dr. Ethel Elderton's exhaustive study of the changes in the birth rate north of the Humber published more than 20 years ago. The other, by Mr. W. T. Russell, is an examination of the various factors associated with the level of the sex ratio at birth in mankind, being based mainly upon the statistical records of England and Wales and the United States. The available data suggest that in the former the proportion of male births has shown a downward trend over the registration period, and, judging by the statistics of christenings in the London Bills of Mortality and by data obtained from Burke's Peerage, this secular trend may well be the continuation of a fall dating back to the early years of the seventeenth century. Both in England and Wales and the United States the sex ratio is significantly lower in the urbanized areas than in the rural districts, a feature which may, perhaps, be due to differences in the incidence of abortions, the latter being, it is generally believed, more largely male. Mr. Russell finds no satisfactory evidence that the sex ratio is influenced by cross-breeding or by age of parents. It declines with increasing size of family and with a fall in social status, phenomena which may clearly be correlated. The ratio was high in the years succeeding the World War, both in belligerent and neutral countries but in a less degree in the latter.

Mr. Martin concludes that the decline in the birth rate began in Wales as far back as the decade 1870-80, in southern England as a whole some ten years later, and the fertility in both areas in 1930-32 was less than half that recorded sixty years previously. The change in the age constitution of married women due to later age at marriage appears to be a factor of no appreciable importance. The rate of decline has been far from uniform, a rapid acceleration being apparent in the years of the present century.

THE section "Etudes scientifiques d'ordre statistique" of the *Revue de l'Institut International de Statistique* for July, 1936 (4 année, livraison 2) contains two papers: *Sur la détermination statistique de la position d'équilibre cyclique*, by J. Tinbergen, and *La dimostrazione razionale della curva normale di probabilità e il libero arbitrio*, by Felice Vinci. A summary of the first is given in English and of the second in French and English. The second section of the *Revue* consists of reports and communications to be given at the session of the Institute at Athens in September. They include: a report on criminal statistics presented by M. E. Schäfer on behalf of the joint commission set up by the International Institute of Statistics and the Commission Internationale Pénale et Pénitentiaire; a paper

by Karl Pribram "How to ascertain the definition of some notions which are fundamental to business cycle analysis?"; the report of the Commission for the study of the use of the correlation coefficient, presented by M. Fréchet; proposals by M. Molinari for the compilation of international statistics of tourism; and papers by M. van Zanten and M. Idenburg on uniformity of accident statistics and on radio statistics respectively.

It is not often that statistics are available to check accounts of distant historical events, but an interesting example of their use in this way is given in a recent publication of Harvard University* (*The Incidence of the Terror during the French Revolution*). The author, Mr. Donald Greer, has examined the records of the numerous Tribunals which operated in Paris and the provinces during the eighteen months between March, 1793, and August, 1794, and has analysed the number of death sentences imposed with a view to seeing what light they throw on the various theories which have been put forward as to the operative causes of this period of the Revolution. The results should be of considerable value to students, and they are of interest to the ordinary reader. A few outstanding points may be mentioned.

The total number of death sentences was 16,594, and in this respect the Terror was no more sanguinary than other repressions, though it has to be remembered that these figures only include those executed after legal trial: large numbers, of whom there are no accurate records, were executed or lost their lives in other ways. These death sentences, whether classified geographically, or according to the nature of the indictment, or the social position or occupation of the victims, all point to the conclusion that the Terror was not, as has often been supposed, a class-war directed mainly against the aristocracy, but was an instrument for the repression of counter-revolution, open revolt or political heresy wherever it was found.

For example, of the 14,080 victims whose vocations are clearly ascertainable, it appears that 6½ per cent. belonged to the clergy, 8¼ per cent. to the nobility and 14 per cent. to the upper middle class, these three groups representing less than one-third of the whole; while 10½ per cent. belonged to the lower middle class, 28 per cent. to the peasantry, and 31¼ per cent. to the working class. Thus the lower grades supplied two victims to every one from the upper classes, which suggests that punishment was inflicted on the enemies of the Revolution regardless of their social caste. The diversity of

* Harvard University Press, 1935. Pp. 196. (London: Humphrey Milford, Oxford University Press.)

occupations is remarkable, and there seems hardly a profession, trade or vocation from the highest to the lowest which is not represented.

The geographical incidence showed extreme variability: there were 6 Departments in which no death sentences were imposed, and 55 others where the numbers were from 1 to 50, with a total for 61 Departments of 709 executions; at the other end of the scale were 5 Departments which accounted for 11,569 executions, or 70 per cent. of the total. The Departments where the executions were specially heavy were those where counter-revolution developed into civil war and led to major military operations; those Departments which manifested little opposition were hardly touched. In the same way, an analysis of the indictments shows that 93 per cent. of them related to sedition and other charges of counter-revolution, while the convictions for violation of the economic legislation of the period are almost negligible.

Of course, the nobility, clergy and the rich suffered more in proportion to their numbers than the lower classes, because there were only about 1,200,000 of the former to 23 millions of the latter, but there seems little evidence in these figures that the Revolutionary Government waged war against them as such. It was merciless to its enemies whatever their rank, and in this respect it is probably paralleled by modern examples. Over the whole period, however, the distribution in point of date is very uneven, and there seems a possibility that in the concluding two months there was more attempt to direct revolutionary justice against the upper classes, especially in Paris.

Full references are given throughout the text, and there is an extensive bibliography of material used in compiling the tables.

The Society has received from Professor Maclean of Wilson College, Bombay, a specimen of the examination paper in mathematics and statistics and nomograms set for the intermediate Arts and Science examination at the University of Bombay, and of duplicated notes used at the College in teaching the subject. The standard is very high. The examination paper includes questions on direct and inverse interpolation on the normal law and on skew distributions, the analysis of variance, Latin Squares and on the construction of nomograms.

Professor Maclean has undertaken a courageous experiment which deserves success.

OBITUARY.

SIR WILLIAM HEATON HAMER, M.D., F.R.C.P.

THE death of Sir William Hamer on July 7th has deprived the Society of a valued colleague. Sir William, who was knighted in 1923, was born in 1862, became a scholar of Christ's College, Cambridge, and graduated (12th Wrangler) in 1882. He entered the medical profession, qualifying in 1882, and proceeded M.D. in 1890. Almost the whole of his professional life was spent in the public health service, and he succeeded the late Sir Shirley Murphy—also a highly esteemed member of our body—as Medical Officer of Health and School Medical Officer of the Administrative County of London in 1912. He retired in 1925. Sir William Hamer became a fellow of the Society in 1911, and served on the Council from 1914 to 1918 and almost continuously from 1923 to 1934. He was a Vice-President in the Session 1925–26. Although he did not contribute any paper to our proceedings he frequently took part in discussions; indeed, whenever any medical-statistical subject was under consideration, we could count upon a wise and witty contribution from him. As recently as January of this year he contributed some characteristic remarks to the discussion on Dr. Bradford Hill's paper, although he was not able himself to be present. These various printed notes give some idea of Hamer's intellectual quality; of his acuteness, his humour and his discursiveness. As a critic he was Socratic in his skill in detecting a logical fallacy. As an original investigator, particularly in his work on epidemic constitutions, he displayed a wide imaginative grasp, but was, perhaps, deficient in lucidity. But his writings give a very imperfect idea of the man himself. Our society has owed much to three eminent medical men; Guy, Shirley Murphy and Hamer. Guy belongs to an earlier generation; he died more than fifty years ago and there can be few alive to whom he was personally known. Tradition suggests that he was masterful and his writings are those of an earnest and enthusiastic rather than of a profound student. Shirley Murphy and Hamer were the personal friends of all who have been intimately concerned in the society's affairs during the last thirty years. In some respects they differed greatly. Murphy's mind was the more powerful, the more masculine, Hamer's the more subtle and the better trained. In one respect they perfectly agreed, viz., in the delicate kindness with which they helped and encouraged younger men, a kindness without any trace of pomposity or patronage.

Their influence on our affairs was never ostentatious but always powerful for good. Thanks to them, we were never without highly expert advice on medical-statistical questions, and to them we largely owe the high standard of our medico-statistical discussions. Hamer has left a place which it will be difficult to fill.

M. G.

H. S. FOXWELL.

PROFESSOR HERBERT SOMERTON FOXWELL, economist and statistician, was born at Shepton Mallet, Somerset, 17th June, 1849, and left us on 3rd August, 1936. He became M.A. of London University in 1867; went to St. John's, Cambridge, in the following year; joined our Society in 1878 and, though he had not Goschen's "passion for statistics," was well aware of their value, served on the Council, gave us books, and was a faithful member to the end of his life. But it was in Economics that he did his best work, and that of a very high order indeed. At St. John's he laid a broad foundation, in Moral Science, International Law, and Philosophy, so absorbed in the last as to draw a reproof from Henry Sidgwick: "If I paid so much attention to Spinoza in my lectures on Metaphysics he would be unable to recommend Trinity men to attend them." This is from a letter of 22nd June, 1930, which goes on: "I read Mill and Bain at school.* I think Bain the abler and more original of the two, but I soon dropped both when I came to read bigger men; and I must say that I have borne Mill a grudge for the soporific influence his amiable persuasive style had upon me for some ten years. It was not till I had spent a year lecturing in Leeds that I began to take any real interest in Economics. Mill left the impression there was nothing more to be done, but, as soon as one got up against realities, one felt that everything had to be done and a great deal to be undone." "One doesn't blame Mill, because the son of such a father was bound to have all originality crushed out of him. But he set back the natural development of economics in England for a generation." He says much the same of Ricardo, and thought both Mill and Marshall were worshipping in him the wrong divinity.

Having such sentiments, he was drawn to Jevons, whose *Currency and Finance* he edited in 1884. He found Edgeworth too fond of abstractions. In a letter of 8th October, 1894, he writes: "I hear constant complaints about the abstract character of his contributions to the [*Economic*] *Journal*, most of which ought to go to the *Journal* of the R. S. Society." Edgeworth is "a mathematician

* Yet he writes (on 4th June, 1901), "I was brought up in an atmosphere of business and railways," and rather preferred to talk to business men than to University folk.

choosing for his data economic fictions. He is the sort of man who without the slightest ill feeling would have gone a-fiddling while Rome burned. However, he is personally one of the most excellent and charming of men, which is more important, after all. Science can be imported from Germany, but human beings are rare."

Something of this censure and the whole of its palliation can be applied to Foxwell himself. A friendship began with a censure and difference. Even Wicksteed had awe before him. "If Foxwell had been here I should not have ventured to put it in that way," said Wicksteed once, standing before the blackboard in Beeton's house, criticizing Marshall, and chalking out a curve in illustration.*

Marshall was not left scatheless by Foxwell himself, but for all that, "I never recommend any book more elementary than Marshall's *Elements* except where I am forced to do so against my own judgment. In Economics, as in Medicine, there are limits of safety which compel the prescription of a substantial amount of a study" (letter of 15th September, 1893). But it is not of Marshall but of Adam Smith † that he writes (in 1922), "he is the one economist who lives for me, though I am very far from agreeing with his Mandevillian social philosophy."

To be all alive is not necessarily to be free from error, but perhaps exactly the contrary. There would have been ample criticism of Adam Smith if Foxwell had ever carried out the edition of the *Wealth of Nations* which he once projected (letter of 18th October, 1895).

Foxwell succeeded Jevons in the chair of Political Economy at University College in 1882; he had by this time been well recognized as a leader of economists. He did not agree with Jevons over the abolition of the Corn Tax, but said that Jevons stated his case very much better than the other assailants of it. Jevons pleaded, *inter alia*, "that the repeal of this duty would also reduce whatever appearance of unequal pressure upon the poorer class may appear" in his tables (letter of 1903). Foxwell never lost his own keen sympathy with Labour. He had shown it very strongly in the address of 1886 on "The Irregularity of Employment and Fluctuations of Prices." He considered that "uncertainty of employment is the root-evil of the present industrial regime" (opening words of the address). This is perhaps the most striking of all his fugitive

* A personal recollection.—J. B.

† He was glad to find that his hero did not scribble on his books, "unlike Cliffe Leslie whose dirty books suggest that they had been housed in some Irish cabin" (letter of 1st June, 1894). But there were limits to his admiration: "I told Keynes I object to encouraging all and sundry to worry librarians, the most overworked and underpaid of the intelligent workers, just to see what is probably the worst bookplate ever made" (9th March, 1932).

pieces, and it is here that he deplores the absence of statistics to bring out the difference between the rate of wages and the actual earnings of the wage-earner. "In an analysis of 273 cases made by my brother, Dr. Arthur Foxwell, in Manchester, he found that where the nominal wages varied from 14s. to 35s. a week in different occupations, the highest average earnings were those of the regularly employed corporation labourers whose nominal wages were 20s. Twelve joiners nominally receiving 26s. 9d. a week averaged only 13s. actual earnings, and four masons nominally receiving 35s. averaged only 10s." (p. 14 of the separate copy of *Irregularity* printed by the Edinburgh Co-operative Printing Co., 1886). In this address, as elsewhere, he had laid great stress on the necessity of principles,* but the quotation shows that he had the details ready. It also shows that in 1936 we still have the same difficulties as in 1886, though we have mitigated some of their effects.

Between these two dates Foxwell had many battles to fight, sometimes supported by his brother economists, sometimes against them. He was against the majority of them when he pleaded for Bimetallism, where, on the lines of Jevons, he stated the case better than Jevons himself. Before his marriage he gave quite a half of his time and more than half of his energy to this cause (letter of 22nd November, 1903). Unlike Jevons (see *Statist. J.*, p. 547, Part III, 1936), he was a good lecturer; and on currency and banking he lectured in the City of London with much acceptance. The School of Economics, on its foundation in 1896, made him its Lecturer on these subjects.

Whether he made as good a defence for tariff reform as for bimetallism may be doubted. His letters leave the impression that he was sometimes uncomfortable in protectionist surroundings. "If the Liberal Party were only sound on Foreign Policy I would vote for them" (24th April, 1903).

He had well-deserved glory in later life for his Book-hunting. The story of his first collection is told by himself in the second edition of Palgrave's *Dictionary of Political Economy*, 1925, edited by Henry Higgs, Vol. I, pp. 870-72. By this record Foxwell thinks he got the first impulse towards collecting from Jevons about 1875, and began with Gardner's *Railway Economy*. The special devotion to books connected with the Industrial Revolution was due to talks with Arnold Toynbee (about 1880?). "After 30 years of labour the catalogue [of his first library] contains over 30,000 distinct entries" (p. 870).

The Times of 4th August, 1936, in its obituary † tells of a second

* E.g., separate copy, p. 8.

† Confessedly by Henry Higgs, pupil and lifelong friend.

collection, which went to Harvard, and of a third on which Foxwell was at work at his death.

It is a wonderful fact that he read what he bought, an offence to the mere book-hunter. Witness among other evidences the long introduction, of cx pages, which he contributed to the English translation of Anton Menger's *Right to the Whole Produce of Labour*, translator M. E. Tanner, Macmillan, 1899. Menger's book is a statement and criticism of the alleged Right. Dealing, to Foxwell's pleasure, more with principles laid down than with details of their systems, Menger does justice to the English Socialists as the source from which the German Socialists drew their ideas. The Introduction by Foxwell gives a much more complete account of the English, with much that throws light on himself as well as on them. Referring to Adam Smith's statement, "Civil Government, so far as it is instituted for the security of property, is in reality instituted for the defence of the rich against the poor" (*Wealth of Nations*, V, Ch. I, Part II)—Foxwell writes: "It might as truly be said of some democratic governments to-day that they are a machinery on which those who have less property may compensate themselves at the expense of those who have more. The tables have been turned" (Introduction, p. xviii, footnote), and he adds at the end of his Introduction (this time in the text, page cx): "It is far more important and far more practicable to take care that the acquisition of new wealth proceeds justly, than to redistribute wealth already acquired." This is what Ruskin would have called a "golden word." There are others nearly as good.

The bibliographical appendix (II), pp. 189-267, crowns the whole, and was made possible by Foxwell's great library. The contributions of Foxwell to Menger's book are in quantity equal to Menger's own, so that those do not much err who speak of the book as Foxwell's.

He must have enjoyed the labour of the bibliography as well as the labour of the Introduction in that book. At least at that particular time he had no serious reasons for depression, his marriage having occurred only a year before, in 1898. He had occasional lapses in vigour through incessant effort. "I am getting so tired of the various struggles in which my life is spent that we think of chucking everything and going to live in a Devonshire cottage. My work has become the most slavish drudgery, with no time to do anything worth doing"—he wrote on 7th July, 1903.

But his natural buoyancy * appears as late as 19th March, 1926,

* November 4th, 1934. "I have a good appetite and my general health is excellent. But walking has always been the delight of my life and the basis of my rest and holidays, so that I feel the loss of it more than you might think. The paralysis is much less than it was, and I may get rid of it yet."

when he writes: "I feel as if I had twenty years in front of me." He had just ten, but he was mentally active in them; the book-collecting was kept up nearly to the end, as we might judge from the contributions of comments to the entries in the Higgs Bibliography of 1935. Like most men, he was optimist when well, pessimist when ill. Through his 87 years of life he had a fair share of good health, kept up by golf and country air. One enemy, facial paralysis, sometimes presented itself, and his letters spoke now and again of that and internal troubles and colds.

The Times obituary gives the impression that he wrote too little to be a famous author. But good lecturers, and he was one of them, are surely as rare as good authors. He was a power on the academic platform, and he wrote more than enough to support his reputation out of doors.

If his brother economists did not always agree with him, I think they always admitted he was a fair disputant. To be quite fair was his constant desire, and when he saw he was wrong he had the courage to admit his error. Actual changes of opinion were few.

He was inclined to follow Carlyle in hero-worship. A letter of 24th May, 1891, is on the natural in-equality of men. "I do not know whether it gives me more pleasure to follow a good lead or to lead myself, but I am firmly convinced that we cannot all lead, that we are most of us unfit to lead and that the relations of father and son, master and man, leader and led, are in their nature eternal, however they may be disguised, and are not to be superseded by any amount of committee meeting, caucuses or counting heads. I am more and more impressed with the inequality of men and the immense value of superiorities, also with the tedious inefficiency of committees, and the waste of setting twelve men to struggle with weary friction through work which any one of them would do with less fatigue, and more efficiently alone. Cambridge is cursed with this machinery of representation—that I know; and I rather think the nation is too."

These views will need some amendment before our Society or any other can accept them. But the passage is characteristic, and may fitly close this short notice of a much-honoured and beloved friend of fifty years' standing. He was a man of strong sympathies, of which some examples have been given. Also of strong antipathies, with plenty of indignation in him when occasion demanded it, the last man to fiddle when Rome was burning, yet in many ways resembling the brother-economist playfully fancied by him to be capable of that enormity.

J. B.

STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS.

UNITED KINGDOM—

Agriculture, Ministry of, Journal, July, 1936—Egg Quality; the Influence of Climate and Soil: *R. Coles*.

Annals of Eugenics, June, 1936—A Search for Incomplete Sex-linkage in Man: *J. B. S. Haldane, F.R.S.* Heterogeneity of Linkage Data for Friedreich's Ataxia and the Spontaneous Antigens: *R. A. Fisher*. Selection by a nearly Perfect Examination: *F. Sandon*.

Bankers' Magazine—

July, 1936—Overseas Steel Trade Conditions, Britain and Foreign Competition: *E. T. Good*. World Wheat Production: *E. F. Brayham*.

August, 1936—The Money Factor and Economic Stability: *A. H. Gibson*.

East India Association Journal, July, 1936—Government and Rural Development: United Provinces Experiments: *Sir Edward Blunt*.

Eugenics Review, July, 1936—Eugenic Aspects of the Merseyside Survey: *D. Caradog Jones*.

Lloyds Bank Ltd. Monthly Review, July, 1936—How can the Prosperity of Europe be restored?: *Frederick Jenny*.

Meteorological Society, Quarterly Journal, July, 1936—On the Frequency Distribution of Rainfall at the Liverpool Observatory: *R. T. Zoch*. Interpolation of Monthly Rainfall Data: *T. E. W. Schumann*.

Midland Bank, Monthly Review, June-July, 1936—Debts, Gold, and International Recovery.

Royal Society of Edinburgh, Proceedings of, Session 1935-36—The Effect of Present Trends in Fertility and Mortality upon the Future Population of Scotland and its Age Composition: *Enid Charles*.

Sociological Review, July, 1936—The Sociology of Pareto: *Morris Ginsberg*. Further Historical Evidence for the Growth of the Chinese Population: *C. P. Fitzgerald*.

Westminster Bank Review, July, 1936—Our Rising Imports.

UNION OF SOUTH AFRICA—

The South African Journal of Economics, June, 1936—Recent Changes in the Relations between the State and Business: *Sir William Clark*. Health and Agriculture: *R. F. George*.

UNITED STATES—

- American Academy of Political and Social Science, Annals of, July, 1936*—The Attainment and Maintenance of World Peace. (Whole number.)
- Harvard Business Review, Summer No., July, 1936*—The New Deal in Ancient Greece: *C. J. Bullock*. Insurance in the U.S.S.R.: *S. A. Rybnikoff*. A Problem in Industrial Physiology and Medicine: *John H. Talbott*.
- Milbank Memorial Fund Quarterly, July, 1936*—Third Progress Report on a Study of Family Limitation: *Raymond Pearl*. An Inventory of the Serious Disabilities of the Urban Relief Population: *G. St. John Perrott and Helen C. Griffen*. Education and Intramarital Fertility in Stockholm: *E. P. Hutchinson*.
- Monthly Labor Review, June, 1936*—Accident Experience in the Iron and Steel Industry, 1933 and 1934.
- Social Research, August, 1936*—The Soviet Union and the Business Cycle: *Arthur Feiler*.

ARGENTINA—

- Revista de Ciencias Economicas, April, 1936*—Análisis de curvas cronológicas—Cálculos de la variación estacional: *Ricardo L. Rosso*. El control de los cambios en la Republica Argentina: *Jose A. Vido*.

BELGIUM—

- Revue du Travail, Avril, 1936*—La Dentelle Belge en Péril: *Madame Plasky*.

EGYPT—

- L'Égypte Contemporaine, Février, 1936*—Currency and Credit in Egypt: *Ernest Hallett*.

FRANCE—

- Bulletin de la Statistique générale de la France, Avril-Juin, 1936*—La Production Industrielle en France depuis 1928: *Alfred Savvy*. Activité de l'Industrie Cinématographique.
- Journal des Économistes, Mai-Juin, 1936*—Les voies divergentes de l'économie: *Michel Carsow*.
- Société de Statistique de Paris, Journal—Juillet-Septembre, 1936*—Contribution à l'étude du chômage intellectuel: *M. A. Rosier*. Les Prix-Or: *B. Nogaro*.

GERMANY—

- Blätter für Versicherungs-Mathematik, Juli, 1936*—Eine klassische Differenzgleichung: *P. E. Bohmer*.
- Deutsches Statistisches Zentralblatt, Heft 3, 1936*—Der zeitliche Abstand zwischen Eheschliessung und erster Geburt: *Prof. Dr. Johannes Müller*.

GERMANY—Contd.—

Sonderhefte des Instituts für Konjunkturforschung, No. 41, 1936—Die Bedeutung des Aussenmarktes für die deutsche Industrie-Wirtschaft.

Weltwirtschaftliches Archiv, Juli, 1936—Der Weltluftverkehr im Jahre 1934–35: *Carl Hans Pollog*. Der Problem der Kapitalbeschaffung in der chinesischen Volkswirtschaft: *Charles F. Remer*. Die jüngste Handelspolitik der Vereinigten Staaten: *B. B. Wallace*, and *H. V. V. Fay*. Hat das Steigen der Rohstoffpreise zu einer Entflechtung der nationalen Verschuldung geführt?: *Dr. Ellen Quittner-Bartolasi*.

Zeitschrift für die gesammte Versicherungs-Wissenschaft, Heft 3, Juli, 1936—Folgerungen aus dem Zusammenbruche des "Phönix": *Dr. Robert Kerber*. Wirtschaft und Weltanschauung: *Dr. Diedrich Bischoff*.

ITALY—

Economia, June, 1936—Corso corrente e corso normale dei cambi: *Giulio Scagnetti*. La Frequenza degli aborti secondo i rilievi della Cassa di Maternità: *Guglielmo Tagliacarne*. Il Salario corporativo nell'agricoltura e nell'industria: *Pier Ludovico Bertani*.

Giornale degli Economisti—

June, 1936—Natalità e fecondità legittima in Sardegna: *Liberio Lenti*. L'Espansione del Credito: *Bruno Foa*.

July, 1936—La Fecondità legittima nell'Italia centrale secondo l'età della madre e l'ordine di generazione: *Guglielmo Tagliacarne*. La revisione della teoria del commercio internazionale: *Francesco Vito*.

Revista Italiana di Scienze Economiche, May, 1936—Precisazione (Criteri per le compensazioni internazionali): *Francesco Spinedi*. I succedanei del Caucciù: *Vinigi Lorenzo Grottanelli*.

SWEDEN—

Index, July, 1936—The Decline of Fertility in Western Europe: *J. B. Condliffe*.

Skandinaviska Kreditaktiebolaget, July, 1936—The Trend of the Value of Gold: *Prof. Gustav Cassel*. American Commercial Policy from Swedish point of view: *Gunnar Böös*.

INTERNATIONAL—

International Labour Review, July, 1936—Migration and Settlement in Australia, New Zealand, and Canada: *Christie Tait*.

International Review of Agriculture, June, 1936—The Economic Aspect of the Production and Consumption of Coffee. The International Organization of the Sugar Market.

Revue de l'Institut international de Statistique, Juillet, 1936—Sur la Détermination statistique de la position d'équilibre cyclique: *J. Tinbergen*. La dimostrazione razionale della curva normale di probabilità e il libero arbitrio: *Felice Vinci*.

LIST OF ADDITIONS TO THE LIBRARY.

Since the issue of Part III, 1936, the Society has received the publications enumerated below:—

I.—OFFICIAL PUBLICATIONS.

(a) United Kingdom and its several Divisions.

United Kingdom—

General Register Office—

Census of England and Wales, 1931. Hereford and Shropshire (Part II). London: H.M.S.O., 1936. 13" × 8½". 21 pp. 1s. 3d.

Health, Department of, for Scotland—

Scottish Health Services report, Committee on. Edinburgh: H.M.S.O., 1936. Cmd. 5204. 9½" × 6". 404 pp. 6s.

Medical Research Council—

Special report series No. 209. Experimental epidemiology. By M. Greenwood, A. Bradford Hill, W. W. C. Topley and J. Wilson. London: H.M.S.O., 1936. 9½" × 6". 204 pp. 3s. 6d.

Overseas Trade, Department of—

Reports: 641. Germany, to March 1936. 285 pp. 5s. 6d. 2. Mexico, March 1936. 44 pp. 1s. 643. Poland, March 1936. 42 pp. 1s. London: H.M.S.O., 1936. 9½" × 6". 3 parts.

Transport, Ministry of—

Electricity Distribution, Report of the Committee on, May 1936. London: H.M.S.O., 1936. 9½" × 6". 103 pp. 2s.

(b) Dominions, Colonies, and Protectorates.

Canada—

Dominion Bureau of Statistics—

Seventh Census, 1931.

Census of agriculture—Alberta. cxii + 85 pp. Manitoba. cxii + 67 pp. Quebec. cxvi + 197 pp. Saskatchewan. cx + 89 pp. Ottawa, 1934-5. 9½" × 6½". 4 parts.

Census of industry. Wood-using industries in Canada, 1933. 143 pp. 25c. The pulp and paper industry, 1934. 121 pp. 25c. Food products, beverages, rubber, tobacco and miscellaneous manufactures based on vegetable products. 1928-1933. 176 pp. 50c. Ottawa, 1936. 9½" × 6½".

Palestine—

Migration, Department of—

Annual report, 1935. Jerusalem (London: Crown Agents for the Colonies), 1936. 13" × 8". 78 pp. 3s.

(c) Foreign Countries.

Bulgaria—

Direction Générale de la Statistique—

Statistique des accidents du travail 1934. Sofia, 1936. 11½" × 8". 50 pp.

(c) Foreign Countries—Contd.

China—

Industry, Ministry of—

Monthly bulletin, Vol. 1. No. 1, April, 1936. Nanking: the Ministry, 1936. $10\frac{1}{2}'' \times 7\frac{1}{2}''$. 38 + [444] pp.

National Tariff Commission—

Annual report of Shanghai commodity prices 1934. Shanghai, 1936. $10\frac{1}{2}'' \times 7\frac{1}{2}''$. vi + 131 + [6] pp. \$1.20.

Italy—

Istituto Centrale di Statistica—

Decennale 1926-IV—1936-XIV. 154 + 173 pp.

VII, Censimento generale della popolazione 21 aprile 1931. Vol. VI.

Indagine sulla fecondità della donna. 39 + 67 pp. L. 20.

[Rome, 1936. $12'' \times 9\frac{1}{4}''$.]

Mozambique—

República Central de Estatística—

Boletim económico e estatístico, Série especial No. 13. Censo da população não indígena em 2 de maio de 1935. Lourenço Marques, 1936. $11\frac{1}{2}'' \times 8\frac{1}{2}''$. 99 pp.

Netherlands—

Amsterdam. Onderzoek naar den voedingstoestand van schoolkinderen te Amsterdam 1935. Amsterdam, 1936. $9\frac{1}{2}'' \times 6\frac{1}{4}''$. 51 pp. (From Dr. M. G. Neurdenburg.)

(d) International.

League of Nations—

Economic and Financial Section—

Money and banking 1935-1936. Vol. 1. Monetary review. 59 pp.

2s. 6d. Vol. II. Commercial banks. 213 pp. 7s. 6d. Geneva (London: Allen and Unwin), 1936. $10\frac{3}{4}'' \times 8\frac{3}{4}''$.

The problem of nutrition. Vol. I. Interim report of the Mixed Committee on the Problem of Nutrition. Geneva, 1936. $9'' \times 6\frac{1}{2}''$. 98 pp. 2s.

II.—AUTHORS AND MISCELLANEOUS.

Archiv für Bevölkerungspolitik Sexualethik und Familienkunde. 2, 1933. Pp. 89-127. Bibliographie für 1930, 1931, und 1932. Berlin, 1933. $9\frac{1}{2}'' \times 6\frac{1}{2}''$. (From Dr. Kantorowicz.)

Carr-Saunders (A. M.). World population: past growth and present trends. Oxford: Clarendon Press, 1936. $8\frac{3}{4}'' \times 5\frac{1}{4}''$. xv + 336 pp. 12s. 6d.

Clark (Grover). The balance sheets of imperialism: facts and figures on colonies. New York: Columbia University Press. London: H. Milford. 1936. $10\frac{1}{2}'' \times 8\frac{1}{4}''$. xii + 136 pp. 14s.

Crowther (Samuel). \$970,000,000 minus: a second primer, the results of a year of simple arithmetic. New York: the Chemical Foundation, 1936. $10'' \times 7''$. 60 pp.

Eyraud (Henri) and Grand (Marcel). Recherches sur les taux de masculinité. Étude d'une statistique des familles nombreuses du Département du Rhône. [6] pp.

— and *Roux (Jean)*. Sur les corrélations morphologiques application à une statistique d'empreintes digitales, du Laboratoire de Police de Lyon. [6] pp.

[Travaux de l'Institut de Science Financière et d'Assurances, Université de Lyon, Nos. 34-35. $9\frac{1}{2}'' \times 6\frac{1}{4}''$.]

Fisher (R. A.). The detection of linkage with recessive abnormalities. Pp. 399-351. The fiducial argument in statistical inference. Pp. 391-398.

[London: reprints from *Annals of Eugenics*, Part IV, 1935.]

II.—Authors and Miscellaneous—Contd.

- Grotjahn (Martin)*. Alfred Grotjahns bevölkerungspolitische Schriften. Berlin: reprint from *Archiv für Bevölkerungspolitik*, Heft I, 1933. $9\frac{1}{2}'' \times 6\frac{1}{2}''$. 8 pp. (From Dr. Kantorowicz.)
- Gumbel, (E. J.)*. La plus grande valeur. Prague: reprint from *Aktuárské řady*, 1936. $8\frac{1}{2}'' \times 6''$. 34 pp.
- Les valeurs extrêmes des distributions statistiques. Travaux de l'Institut de Science Financière et d'Assurances, Université de Lyon, Nr. 33. $9\frac{1}{2}'' \times 6\frac{1}{2}''$. [2] pp.
- Halbwachs (Maurice) and Sauvy (Alfred)*. L'Encyclopédie française. [Extrait du tome VII (L'Espere humaine)]. Troisième partie. Le point de vue du nombre. A. La population en général. B. Le sexe. C. Le renouvellement des générations. D. Degré de peuplement et migrations. Paris, 1936. $11\frac{1}{2}'' \times 9\frac{1}{2}''$. 8 + 11 + 16 + 16 + 16 + 15 + 8 + 4 pp. (From Prof. M. Halbwachs.)
- Hartog (Sir Philip) and Rhodes (E. C.)*. The marks of examiners; being a comparison of marks allotted to examination scripts by independent examiners and boards of examiners, together with a section on a *viva voce* examination. With a memorandum by Cyril Burt. London: Macmillan, 1936. $9\frac{1}{4}'' \times 6''$. xix + 344 pp. 8s. 6d.
- Hilton (John)*. Industrial Britain: synopsis of twelve talks to be broadcast. 1934. London: B.B.C., 1934. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. 48 pp. 6d.
- Incorporated Association of Rating and Valuation Officers. 54th Annual Meeting and Conference. Report of the proceedings. London, 1936. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. 282 pp. 10s. 6d.
- Institut für Konjunkturforschung. Beiträge zur Konjunkturlehre. Festschrift zum zehnjährigen Bestehen des Instituts. Mitarbeiter: C. J. Bullock, L. H. Dupriez, C. Gini, und M. Vergottini, A. Gunther, K. Keller, S. Kojima, E. Lipinski, G. L. Schwartz, C. Snyder, J. Tinbergen, S. Varga, F. Vito. Hamburg: Hanseatische Verlagsanstalt, 1936. $9'' \times 6''$. 324 pp. (From Dr. Wagemann.)
- Institut de Statistique Yanagisawa. Bulletin, No. 40. Œuvres choisies du comte de Yanagisawa. Tokyo. 1936. $8\frac{3}{4}'' \times 6''$. 249 pp. [Japanese text.]
- Institut Spraw Społecznych Warsaw. Landau (Ludwik) Bezrobocie i stopa życiowa ludności dzielnic robotniczych Warszawy. Warsaw, 1936. $9\frac{1}{2}'' \times 6\frac{1}{4}''$. 133 pp. + appendices 71 pp.
- Kantorowicz (M.). Alfred Grotjahn's Stellung in der Theorie der sozialen Hygiene. Leipzig: reprint from *Zeitschrift für Schulgesundheitspflege und soziale Hygiene* 1931 Nr. 21. $9'' \times 6\frac{1}{2}''$. 8 pp. (From the author.)
- Bevölkerungspolitik. Berlin: reprint from *Zeitschrift für Gesundheitsverwaltung und Gesundheitsfürsorge*, 1933, Heft 5. $10\frac{1}{2}'' \times 7\frac{3}{4}''$. [10] pp. (From the author.)
- Milbank Memorial Fund. The next steps in public health: proceedings of the 14th Annual Conference. New York, 1936. $9'' \times 6''$. 90 pp.
- Neyman (J.). Sur la vérification des hypothèses statistiques composées. Paris: reprint from *Bulletin de la Société Mathématique de France*, 1935. $10'' \times 6\frac{1}{2}''$. 21 pp. (From the author.)
- Su un teorema concernente le cosiddette statistiche sufficienti. Rome: reprint from *Giornale dell' Istituto Italiano degli Attuari*, October, 1935. $9\frac{1}{2}'' \times 6\frac{1}{2}''$. 17 pp. (From the author.)
- Persons (Warren M.)*. An economist's appraisal of domestic electric refrigeration. New York: Temperature Research Foundation, 1936. $10\frac{1}{4}'' \times 7\frac{1}{4}''$. 15 pp.
- Rivista di storia economica. Diretta da Luigi Einaudi. Anno I. Num. I. Marzo, 1936. Torino: G. Einaudi Editore, 1936. 84 pp. $10'' \times 7''$. L. 12.
- Sayre (Francis Bowes). America must act. Boston, New York: World Peace Foundation, 1936. $7\frac{3}{4}'' \times 5\frac{1}{4}''$. 80 pp.
- Schiller (Karl). Arbeitsbeschaffung und Finanzordnung in Deutschland. Berlin: Junker und Dunnhaupt, 1936. $9\frac{1}{4}'' \times 6\frac{1}{4}''$. 177 pp.
- Sipos (Alexandre). La vie économique en Hongrie pendant et après la crise 1932-1935. Budapest: tirage à part de la *Nouvelle Revue de Hongrie*, (Avril 1933, Mars 1934, mars 1935, mars 1936) 1936. $9'' \times 6''$. 50 pp. 2 pengős. (From the author.)

II.—Authors and Miscellaneous—*Contd.*

Sofia, State University. Publications of the Statistical Institute for Economic Research. 1936. No. 1. Sofia. 1936. 11" 8 $\frac{1}{4}$ ". 82 pp.

Linzi (Felice). Perché non è possibile accertare la cause delle depressioni economiche. Città di Castello: reprint from *Atti dell' Istituto Nazionale delle Assicurazioni*, 1936. 10 $\frac{1}{4}$ " \times 7". 12 pp. (From the author.)

Wald (A.). Berechnung und Ausschaltung von Saisonschwankungen. Vienna: Julius Springer, 1936. 8 $\frac{1}{2}$ " \times 6 $\frac{1}{4}$ ". viii + 140 pp. *Rm.* 7.80.

White (H. E.). Wholesale prices at Cincinnati and New York: Ithaca, N.Y. Cornell University Agricultural Experiment Station, Memoir 182, 1935. 9" \times 6". 42 pp.

Fates (F.). Crop estimation and forecasting: indications of the sampling observations on wheat. London: reprint from the *Ministry of Agriculture, Journal*, May, 1936, pp. 156-162. 9 $\frac{3}{4}$ " \times 6".

— Incomplete Latin squares. London: reprint from *Journal of Agricultural Science*, April, 1936, pp. 301-315. 10 $\frac{1}{4}$ " \times 7".

[From the author.]

PERIODICALS RECEIVED BY THE LIBRARY.

ANNUAL LIST.

In addition to the publications named in the bi-monthly lists, the Society receives the official and other periodicals enumerated below.

(a) United Kingdom and its several Divisions.

*National.***United Kingdom—**

- Admiralty.* Health of the Navy. Fleets. Navy, Appropriation account. Navy, Dockyard expense accounts.
- Agriculture and Fisheries, Ministry of.* Agricultural market report. Economic Series Reports. Journal of the Ministry of Agriculture. Agricultural statistics. Diseases of animals. Land Division, Report. Salmon and freshwater fisheries Report. Sea fisheries: Report; Statistical tables.
- Air Ministry.* Appropriation account. Health of Air Force. Progress of civil aviation.
- Charity Commission.* Report.
- Civil Service Commission.* Annual report.
- Colonial Office.* Annual Colonial reports.
- Control, Board of.* Lunacy and mental deficiency. Report.
- Crown Lands, Office of Commissioners of.* Report.
- Customs and Excise, Commissioners of.* Report.
- Development Commission.* Report.
- Dominions Office.* Report of Overseas Settlement Committee.
- Ecclesiastical Commission.* Report.
- Education, Board of.* Report and statistics. Health of the school child. Memorandum on Board of Education Estimates.
- Electricity Commission.* Annual report. Engineering and Financial statistics. Generation of electricity.
- Forestry Commission.* Annual report.
- Friendly Societies, Registry of.* Reports of the Chief Registrar. Industrial Assurance Commissioner, Report.
- General Register Office.* Weekly return of births and deaths. Quarterly return of births, deaths and marriages. Registrar-General's statistical review.
- Health, Ministry of.* Accounts of the National Health Insurance Fund. Alkali works, report. Annual report. Costing returns. Local taxation returns. Local rates and rateable value. Poor relief, quarterly statement. State of the public health. Welfare of the blind, Report.
- Home Office.* Aliens Restriction Acts, statistics. Criminal statistics. Report of Chief Inspector of Factories and Workshops. Licensing statistics. Police (Counties and Boroughs), reports of H.M. Inspector; Report of the Commissioner for the Metropolis. Prisons and convict prisons. Street accidents, return. Race-course Betting Control Board report. Road accidents caused by vehicles and horses. Workmen's compensation statistics.
- Imperial Institute.* Mineral industry statistical summary.
- India Office.* Statistical abstract for British India. Home accounts. Progress and condition of India.
- Inland Revenue, Board of.* Report of Commissioners.
- Labour, Ministry of.* Abstract of labour statistics. Annual report of the Ministry of Labour. Juvenile employment (London) reports. Ministry of Labour Gazette.
- Lord Chancellor's Department.* Civil judicial statistics.
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